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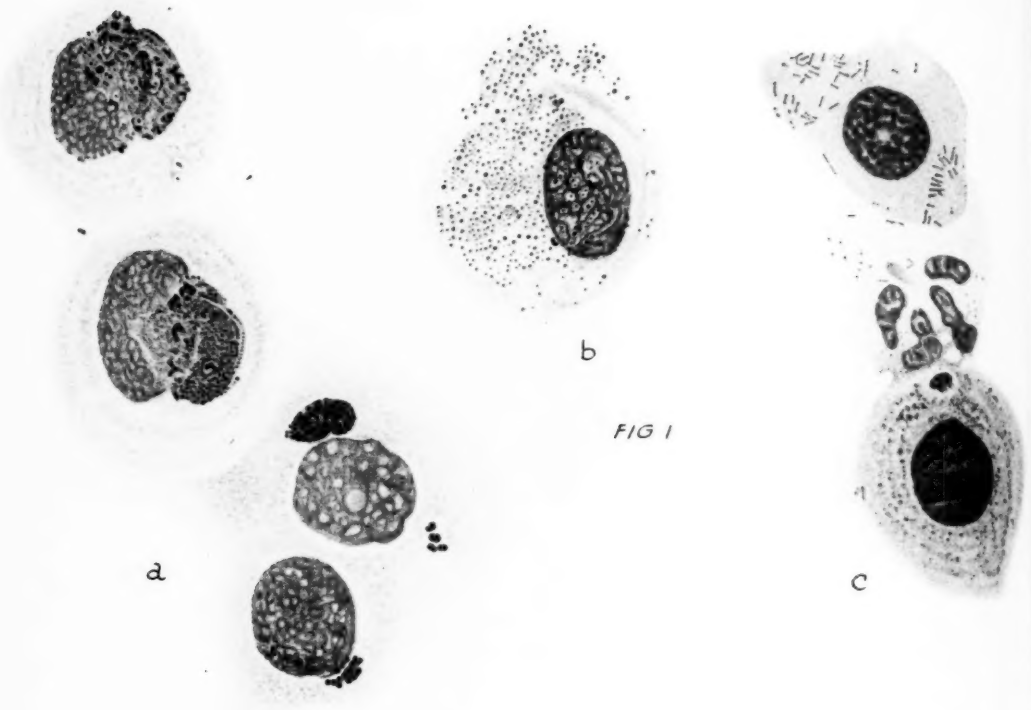


FIG 1

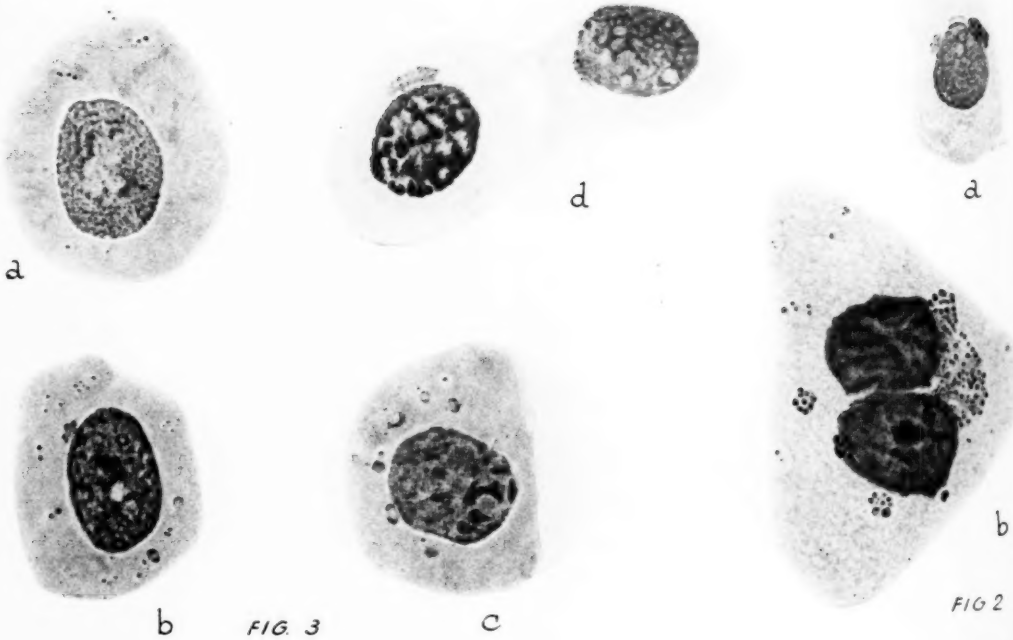


FIG. 3

FIG 2

AMERICAN JOURNAL OF OPHTHALMOLOGY

VOLUME 28 MARCH, 1945 NUMBER 3

ARIBOFLAVINOSIS

IDA MANN
Oxford, England

Ariboflavinosis is rare in England and much confusion still exists concerning its ocular signs. A good deal of clarification is required before one can reconcile such discrepancies in the literature as those between Tisdall *et al.*, who found ocular signs of it in 197 of 198 R.A.F. personnel examined (99.5 percent), Gregory, who only found 31 cases in 1,059 patients (3 percent), Wellwood Ferguson, who found 17 among 250 outpatients (6.8 percent), and Scarborough, who found 70 among 204 patients (34.3 percent).

These discrepancies tend to sort themselves into two groups with a high and a low incidence, respectively, and would seem to depend on whether the observers were ophthalmologists (and therefore conversant with the appearance of the limbus under different conditions and with different kinds of corneal vascularization) or not. Bessey and Wolbach, who showed that the ocular signs of ariboflavinosis could be produced experimentally in rats, pointed out that the earliest detectable sign is corneal vascularization. In spite of this, subsequent observers have extended this statement to include congestion or engorgement of the normal limbal loops as well as what is clearly shown in Bessey and Wolbach's illustrations to be the formation of new vessels on the cornea itself. As ably pointed out by Gregory in 1943, there is often no discrimination in the literature [for example, Sydenstricker *et al.* (1940), and Kruse *et al.* (1940)] between circumcorneal injection and ciliary congestion, and between a full limbus and an actual invasion of the cornea by new vessels. In Sydenstricker's paper reference is made to a "marked congestion and proliferation of the limbic plexus," but no evidence is given for real proliferation as against the filling up of preëxisting but empty vessels. The former is a condition of great rarity, the latter is extremely common under a host of ordinary conditions, as pointed

←

Plate 2 (Loewenstein).

Fig. 1. a, Four epithelial cells from the fornix of an eye, trachomatous for many years, with a fresh gonorrheal infection; four intracellular gonococci in the third cell. b, Mature inclusion bodies with escaping elementary bodies. C, Koch-Weeks conjunctivitis with pseudo-inclusion body. Giemsa staining, ×1350.

Fig. 2. a, Double infection of one epithelial cell with different stage of development of the inclusion body. b, Elementary and initial bodies in the plasma and many inclusion bodies of different stages. Giemsa staining, ×1350.

Fig. 3. a, b, c, are scrapings from the sixth day; d, was taken on the fifteenth day. a, shows elementary bodies only, whereas they are mixed with initial bodies in b and c. The first typical but relatively pale inclusion bodies were found on the fifteenth day (d). Elementary bodies at the borderline of microscopic visibility. Giemsa staining, ×1350.

out by Gregory. Indeed, it may sometimes (from irritative causes quite unrelated to ariboflavinosis) assume striking and peculiar vascular patterns, such as the concentric collateral vessels described by Vail and Ascher (1943). These may come and go in the same individual as the irritation varies, but even when they are not easily visible the empty vessels can always be seen with a slit-lamp.

It would therefore seem unwise to include the full limbus among the signs of riboflavine deficiency, the earliest certain sign of which should be taken to be a budding out of new capillaries from the limbal loops at their apices, with extension on to the true cornea. This should be present in both eyes and around the whole corneal circumference, although it may vary in depth in the two eyes. Even then, the final certainty must be the emptying of the new loops after administration of riboflavine.

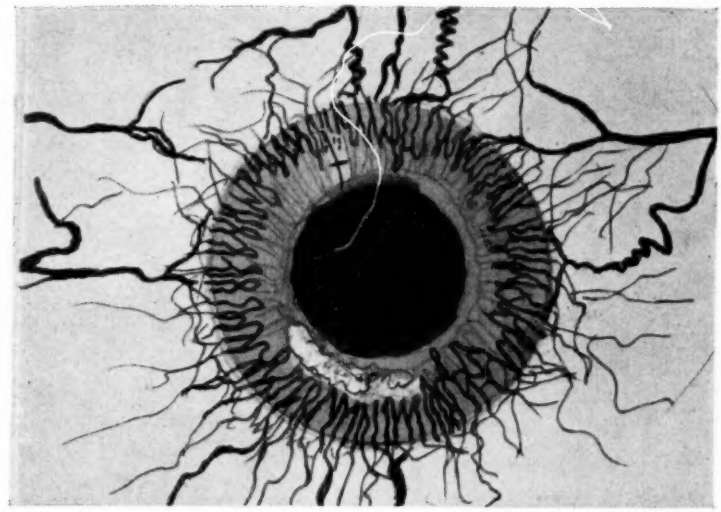
Undoubted cases of riboflavine deficiency have not often been described in detail, so that the following case, which was more severe than those described by Gregory and Wellwood Ferguson, may be of interest. I am indebted to Mr. A. C. Houlton, who first saw the patient and suggested the diagnosis, for the opportunity of following it up.

Case Report

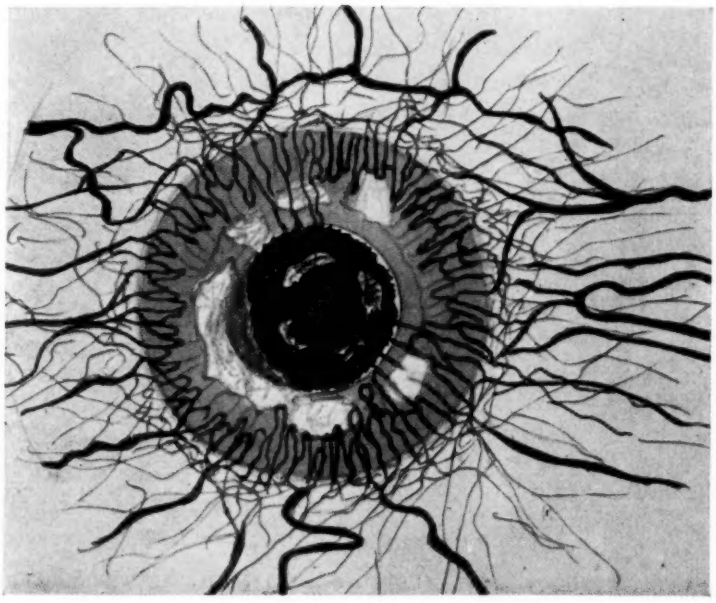
J. H., aged 49 years, a bricklayer, first attended the Oxford Eye Hospital on December 1, 1943, complaining of red and sore eyes, tenderness over the left eye, which was extremely painful, and a dull ache in the right eye, which was also red.

On examination, the patient was seen to be a tall, well-developed, intelligent man; he looked pale and unwell. His eyes were screwed up, red, and slightly lacrimating. The skin at the corners of his mouth was dry and slightly scaly, but not cracked. There was ulceration of the lower gum. The patient was edentulous, wearing a denture. He also complained of slight facial neuralgia. His tongue was clean and red but showed no fissures.

On examining the eyes, visual acuity was found to be 6/6 right and 6/9, part, left. The right eye showed severe conjunctival injection, the main vessels being intensely engorged. The limbal plexus was full. There were no new *conjunctival* vessels. The cornea showed marginal vascularization and opacities in the substantia propria. The vascularization was distinctive. It was in the form of parallel, radially arranged loops springing from the apices of the loops of the limbal plexus and extending in three arcades beyond this, slightly more than half way to the pupil margin. The vessels were so engorged with blood that they appeared to stand out from the surface. They could not be confused with the vessels of an engorged limbus, as the loops were longer and obviously of new formation, extending over clear cornea. They were not like the fine vessels of a trachomatous pannus, nor the brushlike vessels of interstitial keratitis. They were mostly subepithelial, but in the region of the opacities had penetrated the substantia propria to about a sixth of its thickness. They extended all round the circumference of the cornea. The opacities were subepithelial, grayish, about the same depth, or slightly deeper than the vessels, and were curved concentrically with, but farther out than, the pupillary margin. They were coarse, whitish patches in which the corneal lamellae were disturbed and split apart. In the right eye there was one definite one from the 5- to the 8-o'clock position and other faint, doubtful ones.



A



B

FIG. 1 (MANN). THE RIGHT (A) AND LEFT (B) EYES AT THE BEGINNING OF TREATMENT.

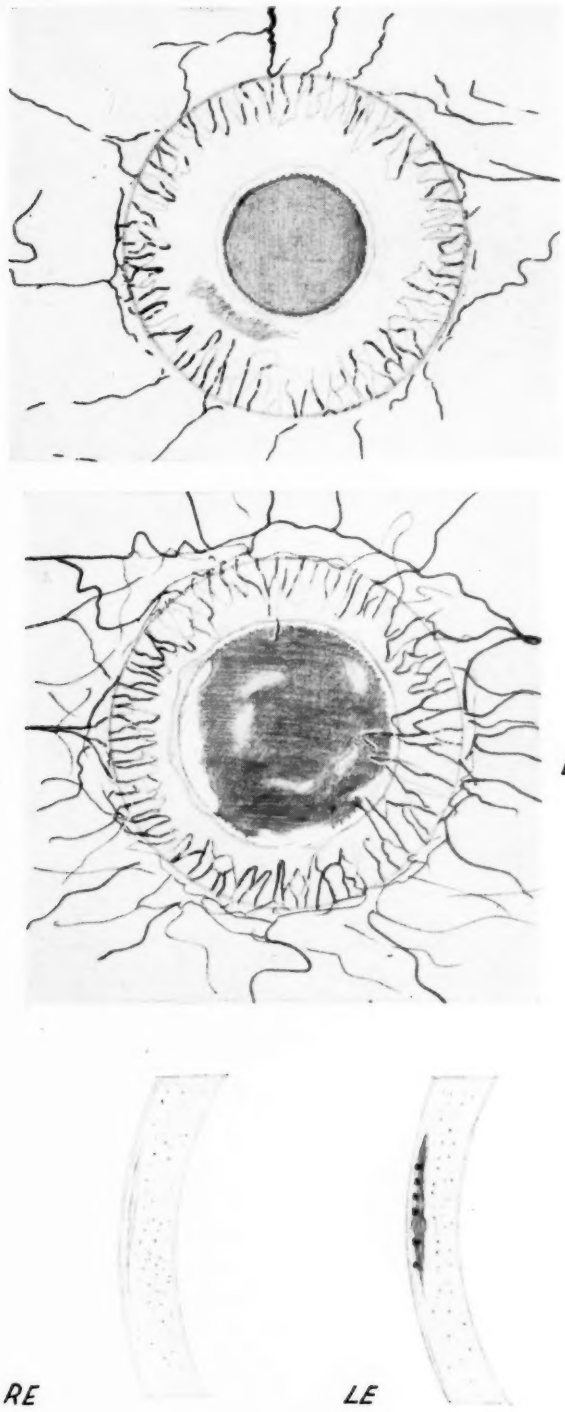


FIG. 2 (MANN). AFTER 10 DAYS' TREATMENT. SLITLAMP APPEARANCES IN REGION OF OPACITIES SHOWN BELOW.

The fundus was normal and the center of the cornea clear.

In the left eye the condition was similar, but much worse. The patient stated that he had had a small corneal ulcer in this eye five years previously, and this may account for the greater severity, as the old scar may have broken down. In this eye there were two concentric rings of opacities, one outside, the other inside the pupillary margin. The rings were not complete, but were broken up into seven or eight separate, somewhat kidney-shaped opacities. One of these showed some loss of substance and could be described as an ulcer, the others were subepithelial. The center of the cornea was clear, and vision remarkably little interfered with, in view of the severity of the condition. The iris was normal in both eyes (see figure 1).

The patient's condition was diagnosed as a case of ariboflavinosis (B_2 deficiency) and he was sent to the Oxford Nutrition Survey for testing. The report showed:

Blood riboflavine—17 μg./100 ml. plasma (low)
Dark adaptation—6° 1.94 log. mμl. (poor)
Blood vitamin A—75 i.u./100 ml. plasma (normal)
Blood carotene—99 i.u./100 ml. plasma (normal)

The poor dark adaptation with a normal blood vitamin-A and carotene content is interesting, in view of Pock-Steen's assertion that "twilight blindness" is an early sign.

The patient was then closely questioned about his habits and diet. He stated that he was engaged in building a hospital, that he lived in a camp with 600 men and had all his meals at a Y.M.C.A. canteen. He did not draw his rations. The nearest inns and shops were three miles away and he did not supplement the canteen food, which was roughly as follows:

7:30 a.m. Breakfast:
porridge occasionally
bread (often sour)
practically no margarine
no butter
ham, spam, or bacon
1 egg in six weeks
10:30 a.m. Lunch:
Tea and bread and cheese, or bread and jam
sometimes margarine
12:30 p.m. Dinner:
once a week meat and two vegetables otherwise ham, spam, minced meat
potatoes (boiled) and beans
occasionally fish or sausages
had carrots twice in six weeks, turnips and onions occasionally
semolina pudding or pie (jam)
applie pie once in six weeks
4:00 p.m. Tea:
tea with dried (skim) milk
bread, cheese occasionally, otherwise jam
6:30 p.m. Supper:
"finished up whatever there had been for dinner"; pickles added, and sometimes ham

No fruit. Green vegetables once a week. Beer once a fortnight, by walking three miles. Tobacco plentiful. The food was cooked a long time before he got it.

The patient began work under these conditions on October 15th. He had previously lived in his own cottage, where he cultivated three quarters of an acre and ate home-grown vegetables. After a little while at the camp he noticed that he often felt very hungry, though the quantity of food was adequate. He did not think the cooking was good, or the food always fresh.

After being examined on December 1st, he was sent back to the camp, told to continue with the food, but to take 15 mg. of riboflavine a day. He returned to Hospital on December 8th, stating that he felt much better in himself, but his left eye was very painful. The visual acuity of the right eye had improved to 6/5 part, but the left was only 6/18, probably due to the corneal ulcer. The ocular condition was about the same, and he was admitted to the Hospital, given atropine

to the left eye, riboflavine, as before, and the ordinary hospital diet:

Breakfast:
Bacon and potatoes
or porridge and potatoe cakes
or scrambled egg
Tea with milk
Lunch:
Cocoa made with milk, and biscuits
Dinner:
Irish stew and vegetables
Milk pudding
or
Roast mutton and 2 vegetables (potatoes and greens or carrots, etc.)
Pastry
or
Fish and 2 vegetables
Chocolate pudding
or
Meat pasty and 2 vegetables
Apple fritters and milk pudding
Tea:
Bread and butter (and jam)
or sandwiches
Supper:
Fish pie
Blancmange
or
Soup; bean pie
Milk pudding
or
Macaroni cheese
Milk pudding
or
Liver and bacon
Milk pudding

Within four days the congestion of the new vessels in the right eye was reduced to half and the left was improving. On December 21st he was discharged, feeling quite well. The right eye looked normal to ordinary inspection, but with the slit-lamp all the vessels could still be seen, although most of them were empty, with an occasional spurt of corpuscles. The opacity was still visible, but was less. There were no subjective symptoms.

The left eye was still under atropine, and there was slight photophobia. It was still redder than the right. The vessels were emptying and the opacities clearing (fig. 2). The pain and tenderness had all disappeared. Visual acuity had improved to 6/9. The ulcer in the mouth had healed, the skin of the angles of the mouth was normal, and the patient felt quite well.

The patient was finally seen on April 26th. He had left the camp and was living at home, having no treatment and feeling very well. Visual acuity in the right eye was 6/5 and in the left 6/6 with correction (right emmetropic, left -2.50D. sph. $\bigcirc$ -0.50D. cyl. ax. 90°).

The new vessels in the right eye were all completely emptied, but were just visible by retroillumination with the slit-lamp. The corneal opacity seen in figures 1 and 2 was still evident. It was narrower and showed a brown pigmentation similar to that of a Hudson's line. This was just subepithelial, and the anterior third of the substantia propria was seen to be involved in the opacity. The left eye also was quite clear, although the ring of opacities was still present. A few of the vessels still conveyed circulating blood. The majority were empty. The opacities in the cornea appeared more fluffy and less dense than previously. The epithelium was intact, and the anterior segment of the eye apart from the cornea quite normal.

There are many points of interest in this case. The new formation of corneal vessels round the whole circumference in both eyes in undoubted and very characteristic. The concentric arrangement of the opacities just beyond the tips of the new vessels has not been specially noted before. Sydenstricker gives no details and Wellwood Ferguson states that he has not seen opacities in any of his English cases. The fact that the old ulcer broke down in the left eye may account for the greater pain in this eye, the other opacities in both being subepithelial. The passage of the vessels more deeply into the substantia propria in the neighborhood

of the opacities has not been described before, neither has the slitlamp appearance of splitting of the corneal lamellae in the opacities, as far as is known. The rapid emptying of the vessels under riboflavine treatment can probably be considered diagnostic, in spite of the improved diet and one day of Multivite tablets while in Hospital. It will be seen that the condition when well marked is very characteristic. It could not easily be diagnosed as anything else, certainly not as either rosacea keratitis or interstitial keratitis. The cure was quite dramatic, the eye which received no local treatment doing as well, or better, than that which had atropine.

Summary

A case of ariboflavinosis is described, with details of new vessels and type of corneal opacity.

The Eye Hospital.

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THE SPACE EIKONOMETER TEST FOR ANISEIKONIA*

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It is universally recognized that the position of objects in the field of view can be more accurately estimated by binocular vision than by uniocular vision. In any activity wherein accurate knowledge of the position of objects in the field of view is important, it is recognized that excellent binocular vision is necessary.

Various tests and procedures have been devised to determine the degree of excellence of binocular stereoscopic vision. These have all taken the form of determinations of the accuracy with which an observer can judge the distances between closely juxtaposed test objects (the actual positions of which are known where actual objects are used, or their disparity where stereoscopic cards are used).

Such tests are based on the assumption that binocular vision provides a basis only for a more accurate judgment of the relative distance between objects; that is, of relative depth. These tests usually are restricted to the central or axial field of view. Recent investigations, however, have shown that this is too limited a concept of the spatial clues provided by binocular vision; that, in fact, binocular vision not only provides a basis for estimating the relative distance between axial objects, but also for accurately estimating the position of objects relative to the observer and relative to each other. This more extended capacity might be called "binocular spatial localization."

While the aforementioned so-called "depth perception" tests disclose whether or not the two eyes are being used together in binocular stereoscopic vision and the accuracy of the relative "depth perception" with respect to two juxtaposed objects, they do not give any indication of the normalcy or abnormalcy of the observer's "spatial localization"; that is, whether or not the observer sees objects to be situated where they actually are. An observer can have very accurate relative "depth perception" for juxtaposed objects and yet localize objects incorrectly relative to himself and relative to each other.

The correctness of a subject's binocular spatial localization is determined by the nature and amount of the anomalous incongruity between the ocular images received from the two eyes. Normal binocular spatial localization is based on a normal incongruity of the ocular images due to the separation of the two eyes. Where the incongruity of the ocular images differs from the normal, anomalous spatial localization will result.

Early in the research in aniseikonia, it was recognized that differences in the size and shape of the ocular images from the two eyes have an important relationship with binocular (stereoscopic) spatial localization. Objects may appear to be at different relative distances from each other and from the observer than they actually are, their shapes and sizes may appear to be altered, surfaces may appear to be tilted or inclined in directions different from what they actually are. This spatial localization is a phenomenon of

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† The author wishes to express his indebtedness to Prof. K. N. Ogle for invaluable assistance in the development of the space eikonometer, and to Prof. R. J. Beitel, Jr., for the preparation and presentation of the material contained in this manuscript.

stereoscopic vision; it takes place over the entire binocular visual field and is not restricted to discrimination of differences in depth only in the central field of vision. The basic facts concerning the relationship between anomalous binocular spatial localization and the differences in size and shape of the ocular images were brought out first in the early studies on the horopter[1] and later on the "tilting boards"[2] and "leaf room."[3] These experiments have shown that individuals with normal eyes are very sensitive to changes in the relative size and shape of the ocular images. They can discriminate changes in binocular localization resulting from the introduction of size differences of as little as 0.125 percent to 0.25 percent between the images in the two eyes. Both the apparent changes in localization and the accuracy of discrimination approach the theoretic maximal limits to be expected, the freer the field of view is from uniocular clues to localization, such as perspective from rectilinear detail and from known forms. Where such clues are present, as in the average room, the spatial distortions may not even be apparent. It must not be concluded from this that the incongruity of the ocular images—that is, the aniseikonia—is in some way compensated for. Rather, the observer is relying predominantly upon the uniocular clues here and is not responding to the binocular stereoscopic clues (disparities between the two ocular images) for localization.[4]

The immediate and significant conclusion to be drawn from such results is that one's ability to localize objects accurately—that is, to see things *where* they actually are—can be markedly impaired by aniseikonia. Since it is *where* we see things that primarily determines our motor innervations and muscular responses, both bodily and ocular, it at once becomes clear how aniseikonia can make it impossible for us to function efficiently or successfully. It is reasonable to believe, for instance, that the symptoms reported by aniseikonic patients may be traced to the frustrations attending the conflicting activities resulting from false localization.

With this in mind it was decided to explore the possibilities for developing a test means whereby the nature and amount of aniseikonia could be determined from the way in which an observer might localize certain test elements in space. The problem in design was to obtain a test field or environment the elements of which could be used, alone or in combination, to differentiate and measure each of the various types of aniseikonia. In instruments for determining binocular spatial responses, it is necessary to eliminate all empirical or uniocular clues which would tend to interfere with the "pure" *binocular* (stereoscopic) space perception; that is, the space perception derived solely from disparities of the images in the two eyes. The simplest possible nonconflicting types of contours are necessary, adequately screened from other objects and influences that might yield spatial clues. A satisfactory method was achieved with the development of the "space eikonometer."

It will be the purpose of this paper (1) to describe the space eikonometer, (2) to describe the various types of aniseikonia and their effect on localization of the test elements, and (3) to describe the technique for measuring the amount of aniseikonia by means of the space eikonometer test.

The space eikonometer

The space eikonometer will be described in two parts: (a) the test elements of the target, and (b) the test lens unit before the observer's eyes. See figure 1.

THE TEST ELEMENTS OF THE TARGET

The essential test elements of the space eikonometer target are:

(1) Four smooth vertical plumb lines or cords;

(2) A cross (or X) consisting of two smooth cords at right angles to each other and at 45 degrees to the vertical lines;

(3) A removable vertical plumb line which passes through the center of the cross.

For easy identification, the smooth cords of the various test elements are colored differently.

The cross, stretched within a frame 5 feet square, is set up at a distance of 10 feet from a headrest for the observer. The center of the cross is at the height of the observer's eyes (49 inches—average height of eyes of seated person) above the floor. The plane of the cross is carefully mounted at right angles to the floor and to the objective median plane of the observer. The cords of the cross are colored red. A hole is bored in the top of the frame so that a cord with a plumb bob that passes through the center of the cross can be lowered, when desired. This smooth cord, which is colored white, can be raised or lowered from the side of the frame.

Two vertical plumbs are suspended both in front of and behind the cross at distances of 24 inches. These cords are separated 19 inches, equidistant from the objective, median plane of the observer and also at right angles to that plane. The visual angle subtended by these cords is approximately 11 degrees. The smooth cords in front are colored green; those behind, white.

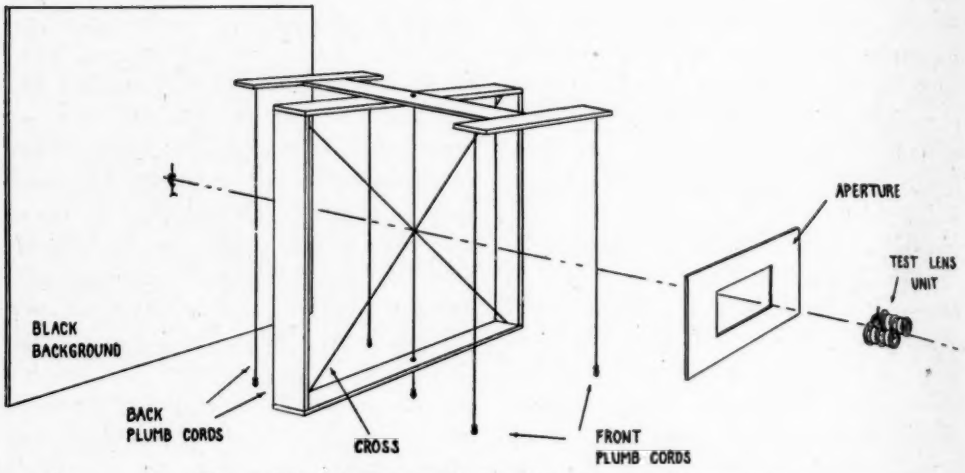

Fig. 1 (Ames). Schematic drawing of space eikonometer.

In order that the test elements shall be as free as possible from empirical clues, the cords used are quite small. Theoretically, the thinner they are, the better. Further, the illumination of the test elements must be bright and uniform, without shadow.

For a background, a black cloth is stretched over a frame at a distance of at least 5 feet behind the back plumb lines. This background must be free of detail, such as wrinkles, shadows, or lint, that can be seen by both eyes. In front of the observer is an aperture which restricts the binocular visual field strictly to the test elements. Neither the tops and bottoms

of the test elements nor the frame of the cross is to be visible through that aperture.

THE TEST LENS UNIT

Situated before the observer's eyes is a battery of lenses which is used to measure the amount of magnification necessary to correct the anomalous spatial localization and, from this, the type and degree of the ocular-image incongruities (aniseikonia). If one of the test elements of the target appears incorrectly located, the appropriate change is made in the battery until the test element in question appears correctly located. The change in the lenses measures the magnitude of the anomalous-image incongruity.

The battery of lenses is contained in a phorometer-type mount and consists essentially of four units before each eye.* These units will be described according to the sequence of their position before each eye. See figure 2.

(a) Nearest each eye is an adjustable size unit for changing the image size in the horizontal meridian only (axis 90°). The adjustable size unit consists of a telescopelike system of two lens elements, designed in such a way that a change in axial position of one lens relative to the other changes the magnifying effect of the combination without appreciably changing its (zero) verging power. The scale on the circumference of the unit is calibrated to give the percent magnifying power of the unit corresponding to the different separations of the lens components.[5]

(b) Next is a similar adjustable size unit, one before each eye, for changing the image size in the vertical meridian only (axis 180°).

(c) Behind these units are four lens cells, two before each eye, for holding individual test size lenses when these are necessary. The cell farthest from the eye in each case can be rotated so as to permit adjustment of the axis of a meridional size lens to any desired meridian.

(d) Finally, there is the front unit for determining whether there is a meridional aniseikonic error at an oblique axis. This consists of two 2.0-percent meridional size lenses, one before each eye, geared so that they rotate together equally but in opposite directions. A handle for rotating the two lenses is attached to the right lens. An indicator and scale engraved in degrees show the rotation of the two lenses from the position where their axes are parallel and vertical. The scale reads only to 45° each way, since the maximum effect occurs at that angle. When the reading is a *"positive"* angle, the *axes* of the two lenses will be symmetrically *converged upward.* When the reading is a *"negative"* angle, the *axes* of the two lenses will be symmetrically *converged downward.* The angle of rotation is usually designated by ρ (rho).

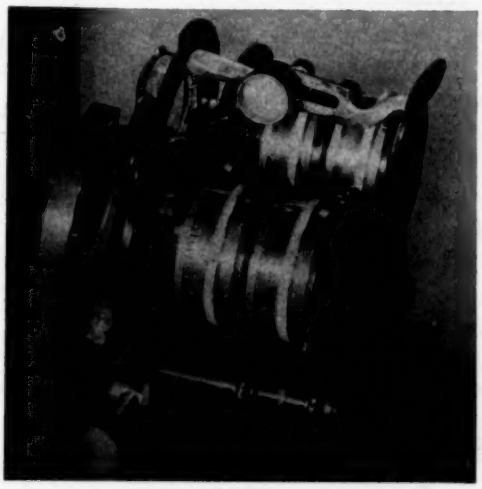

Fig. 2 (Ames). Test lens unit.

*The test lens unit described here is the laboratory or experimental model in use at present. Improvements in design are being developed.

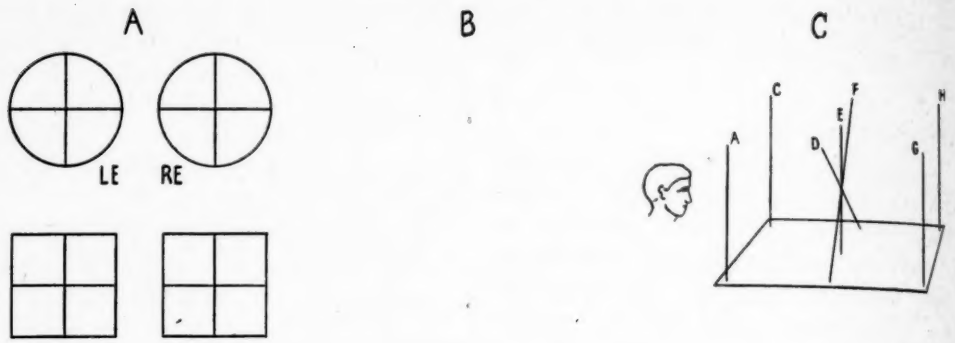

Fig. 3

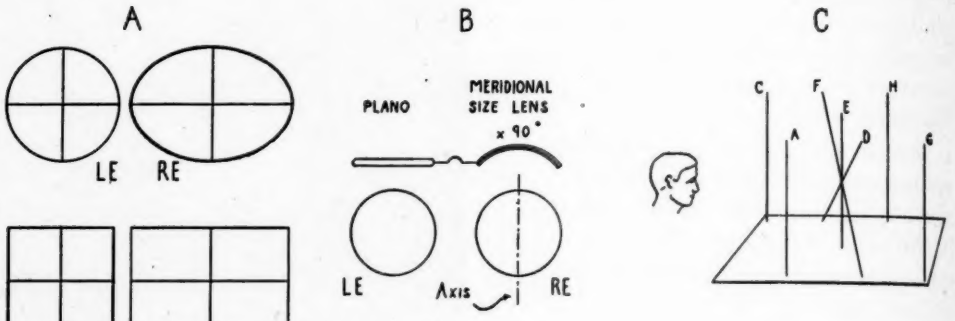

Fig. 4

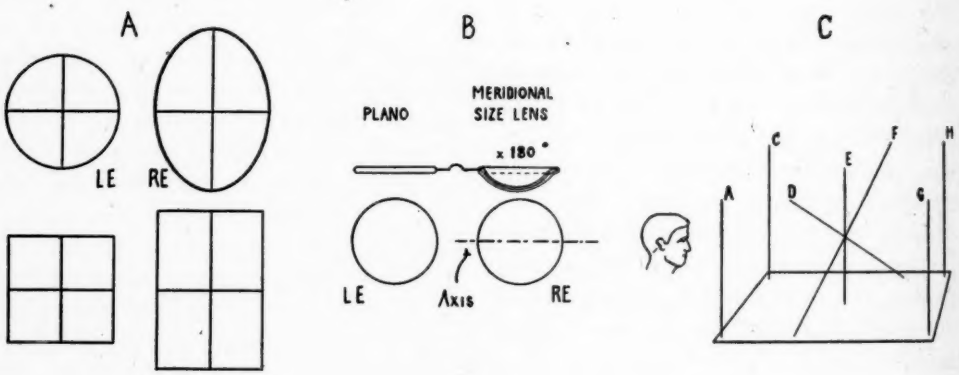

Fig. 5

Figs. 3-5 (Ames). Localization. Fig. 3, Normal localization: normal ocular images. Fig. 4, Anomalous localization: horizontal size difference. Fig. 5 Anomalous localization: vertical size difference.

An interpupillary-distance adjustment screw with scale is provided in the battery mount.

The battery must be kept level. For this purpose, a small spirit level and adjustment screw are attached to the base of the support.

An adjustable chin cup and forehead

rest are provided for positioning the observer's head.

Aniseikonia and anomalous appearance of the target elements

As an aid to understanding the effect of various types of aniseikonia on the spatial localization of the target elements, there follows a series of illustrations, each of which will present diagrammatically the following objects and methods: (a) the particular type of anomalous incongruity, (b) the means (size lenses) for artificially producing such an incongruity, and (c) the appearance of the elements of the target of the space eikonometer where such an ocular incongruity is present.

Figure 3, as a basis for comparison, diagrammatically illustrates the aforementioned conditions where there is no anomalous incongruity of the ocular images. Drawing A diagrammatically shows the ocular images from the two eyes to be of the same size. (Normally, they are not identical due to the separation of the two eyes.) Nothing appears in the space for drawing B because no size lenses are necessary to produce the normal ocular images. Drawing C shows the normal appearance of the elements of the space eikonometer, all of which lie on planes normal to the binocular line of sight (objective median plane of the observer).

Figure 4 diagrammatically illustrates the phenomena associated with anomalous differences in the size of the ocular images in the horizontal meridian (axis 90°). Drawing A diagrammatically shows the ocular image of the right eye to be larger than that of the left eye in the horizontal meridian. Drawing B shows the types of aniseikonic (size) lenses that artificially produce this type of ocular incongruity (R.E. meridional size lens axis 90° and L.E. plano). Drawing C shows the anomalous appearance of the elements of the target of the space eikonometer. The vertical cords C and H will appear nearer the observer, the cords A and G farther away, and the cross formed by the cords D and F will appear as if rotated about the axis E, with the left side of the cross appearing nearer the observer. The direction of displacement of all the elements will be the same, but the amount of displacement of G and H will be greater than that of D and F which, in turn, is greater than that of A and C.* The magnitude of the anomalous spatial localization is given by the magnitude of the apparent displacement of the elements. If the left ocular image was larger than the right in the horizontal meridian, the anomalous appearances would be of the same nature but in the opposite direction.

Figure 5 diagrammatically illustrates the phenomena associated with anomalous differences in the size of the ocular images in the vertical meridian (axis 180°). Drawing A shows the ocular image of the right eye to be larger than that of the left eye in the vertical meridian. Drawing B shows the type of aniseikonic lenses that artificially produce this type of ocular incongruity (R.E. meridional size lens axis 180° and L.E. plano). Drawing C shows the anomalous appearance of the elements of the target. The vertical cords, A, C, G, and H will appear correctly oriented, but the cross will appear as if rotated about the axis E, with the right side of the cross appearing nearer the observer. If the left ocular image was larger than the right in the vertical meridian, the anomalous appearances would be of the same nature but in the opposite direction.

Figure 6 illustrates the phenomena associated with an overall difference in the size of the ocular images. Drawing A

* This is owing to the fact that, with a given ocular-image incongruity, the apparent displacement of a given configuration increases with distance.

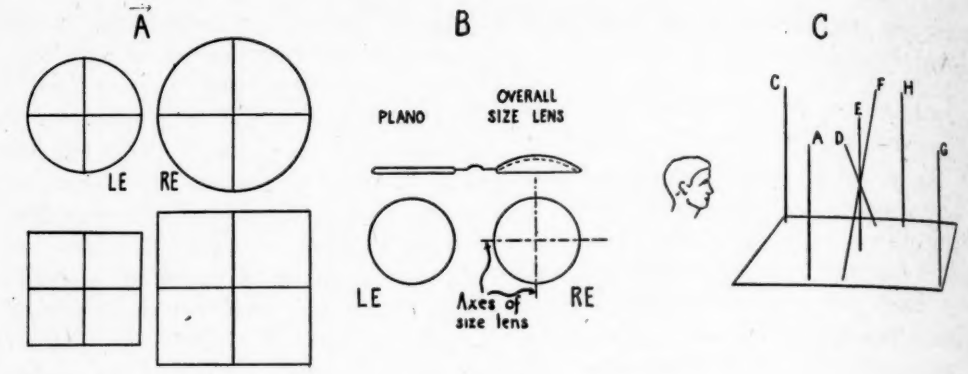

Fig. 6

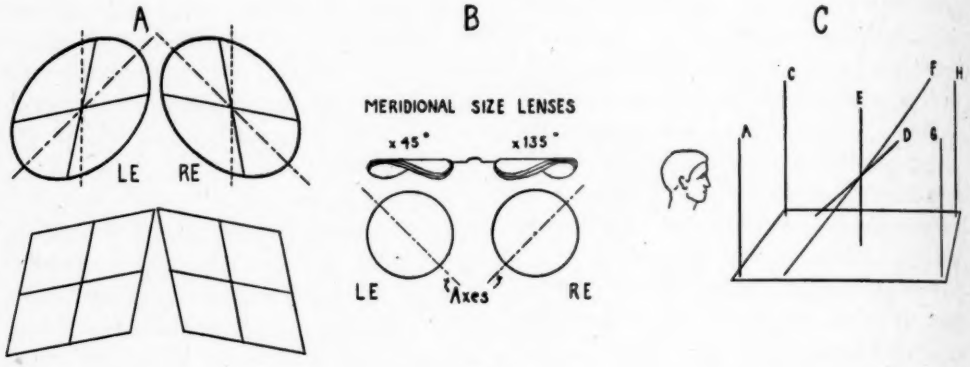

Fig. 7

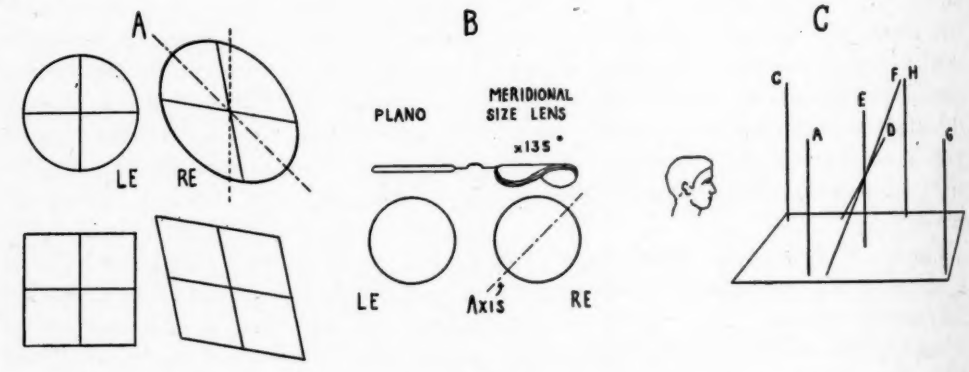

Fig. 8

Figs. 6-8 (Ames). Anomalous localization. Fig. 6, Overall size difference. Fig. 7, Size difference at oblique axes. Fig. 8, Size difference at oblique axis.

shows the ocular image of the right eye to be larger overall than that of the left eye. Drawing B shows the type of aniseikonic lenses that artificially produce this type of ocular incongruity (R.E. overall size lens and L.E. plano). Drawing C shows the anomalous appearance of the target elements. The vertical cords C and H will appear nearer the observer and the cords A and G farther away, but

the cross will appear in its actual position. If the left ocular image was larger overall than the right, the anomalous appearances would be of the same nature but in the opposite direction.

Figure 7 illustrates the phenomena associated with differences in the size of the ocular images in oblique meridians. Drawing A shows the ocular images of both eyes when they are increased in oblique meridians. In this case the images of the vertical meridians of both eyes will be rotated inward at the top. Drawing B shows the type of aniseikonic lenses that artificially produce this type of ocular incongruity (R.E. meridional size lens axis 135° and L.E. meridional size lens axis 45°). Drawing C shows the anomalous appearance of the elements of the target. The vertical cords A, C, G, and H will appear correctly oriented, but the cross will appear tilted away from the observer at the top. If the meridians are rotated in the opposite direction, the cross will appear tilted toward the observer at the top.*

Figure 8 illustrates the phenomena associated with the condition which results when the ocular image of one eye is increased in an oblique meridian at 45°. Drawing A shows the ocular images when the ocular image of the right eye is increased in an oblique meridian at 45°, which causes the image of the vertical meridian of the right eye to be rotated inward at the top. Drawing B shows the type of aniseikonic lenses that artificially produce this type of ocular incongruity (R.E. meridional size lens axis 135° and L.E. plano). Drawing C shows the anomalous appearance of the elements of the target. The vertical cords C and H appear nearer the observer and the cords A and G farther away. The cross will not appear to be rotated about a vertical axis but will appear tilted away from the observer at the top. (With this condition, the ocular image of the right eye is slightly greater in the horizontal and vertical meridians, and there is a relative declination of the image of the vertical meridian outward at the top.) If the axis of the meridional error were at 90° to that above described, the cross would appear to tilt forward at the top, but the vertical cords would have the same apparent displacement as shown.

Figure 9 illustrates the phenomena associated with the condition which results when the ocular image of one eye is increased in the oblique meridian at 30°. Drawing A shows the ocular images when the ocular image of the right eye is increased in an oblique meridian at 30°, which causes the image of the vertical meridian of the right eye to be rotated inward at the top. Drawing B shows the type of aniseikonic lenses that artificially produce that type of ocular incongruity (R.E. meridional size lens axis 120° and L.E. plano). Drawing C shows the anomalous appearance of the elements of the target. The vertical cords C and H appear nearer the observer, the cords A and G farther away, and the cross will appear to be rotated in the same direction about a vertical axis E, and will also appear to be tilted away from the observer at the top. With this condition, the ocular image of the right eye is slightly greater in the horizontal meridian, and there is a relative declination of the images of the vertical meridian outward at the top. If the axis of the meridional error were at 120° to that aforedescribed, the only difference would be that the cross would appear to be tilted forward at the top. (These particular meridians were chosen for this specific example, but

*The direction of apparent tilting of the cross caused by meridional size lenses at oblique axes is opposite to that which would result from viewing a plane surface through the same lenses. Explanation of these phenomena will be dealt with in subsequent papers.

the difference may occur in other oblique meridians, in which case variations and combinations of the appearances will occur.)

Figure 10 illustrates the phenomena associated with the condition that results when the ocular image of one eye is increased in an oblique meridian at 60°. target elements. The vertical cords C and H appear nearer the observer, the cords A and G farther away, and the cross appears to rotate about a vertical axis E, but in an opposite direction to the displacement of the vertical cords, and also appears to be tilted away from the observer at the top. With this condition,

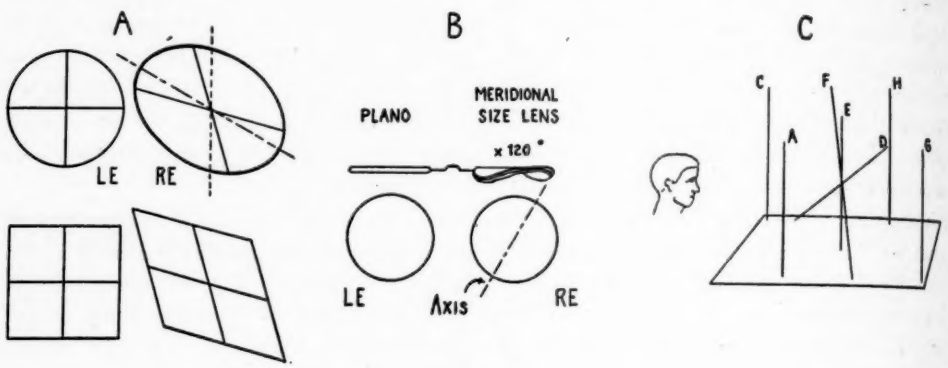

Fig. 9

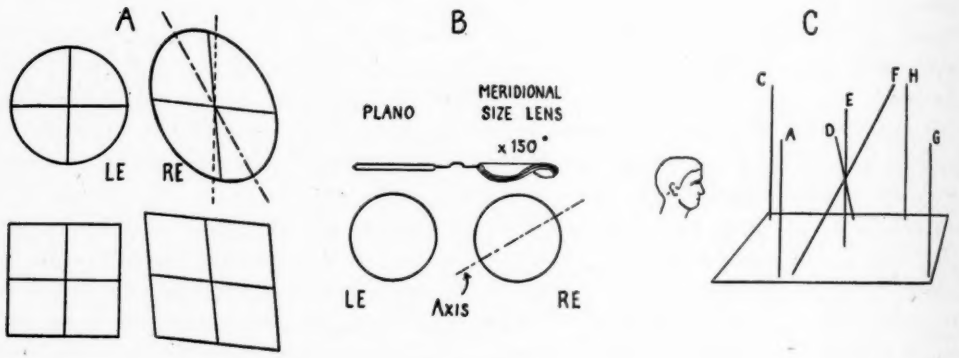

Fig. 10

Figs. 9-10 (Ames). Anomalous localization. Fig. 9, Size difference at oblique axis. Fig. 10, Size difference at oblique axis.

Drawing A shows the ocular image of the right eye to be increased in an oblique meridian at 60°, which causes the image of the vertical meridian of the right eye to be rotated inward at the top. Drawing B shows the type of aniseikonic lenses that artificially produce this type of ocular incongruity (R.E. meridional size lens axis 150° and L.E. plano). Drawing C shows the anomalous appearance of the the ocular image of the right eye is slightly larger in the vertical meridian, and there is a relative declination of the images of the vertical meridian outward at the top. If the axis of the meridional error were at 60° to that aforedescribed, the only difference would be that the cross would appear to be tilted forward at the top. (These particular meridians were chosen for this specific example, but the

difference may occur in other oblique meridians, in which case variations and combinations of the appearances will occur.)

Since these diagrams illustrate specifically the principal types of aniseikonia and the spatial effects associated with them, it will be helpful to describe briefly some of the relationships between combinations of these types of aniseikonia and the appearances of the target elements. It should be borne in mind throughout that the magnitudes of the apparent displacements of the elements increase with an increase in the amount of image size difference. Thus, the greater the size difference between the ocular images in the horizontal meridian, the greater the apparent displacement of the front (and the back) vertical cords. Likewise, the greater the vertical size difference, the greater the apparent rotation of the cross about a vertical axis.

If both the cross and the vertical cords appear to be turned about a vertical axis in the same amount, it means that the size of the ocular image of one eye is larger than that of the other in the horizontal meridian.

If the cross appears to be turned to a greater degree than are the vertical cords in the same direction, it means that the size of the ocular image of one eye is larger in the horizontal meridian and that of the other eye is larger in the vertical meridian.

If the cross appears to be turned to a lesser degree in the same direction, it means that the ocular image of one eye is relatively larger in the horizontal meridian and also in the vertical meridian, but to a lesser degree.

If the cross appears to be turned in the opposite direction to the vertical elements, it means that the ocular image of one eye is relatively larger in the vertical meridian and also in the horizontal meridian, but to a lesser degree.

When the cross does not appear to turn and the vertical elements do, it means that the ocular image of one eye is relatively larger overall than that of the other.

If the cross appears to be tilted away from the observer at the top, it means that the axis of the meridional size correction converges upward toward the median plane (forehead) of the observer.

If the cross appears to be tilted toward the observer at the top, it means that the axis of the meridional size correction converges downward toward the median plane (chin) of the observer.

To summarize, the nature and relative magnitude of the anomalous spatial localization, which is disclosed from the appearance of the space eikonometer target, is directly related to the type and degree of aniseikonia present.

General procedure of the space eikonometer test

With this description of the various types of aniseikonia and their effect on spatial localization, the general nature of the methods used for determining the nature of a subject's ocular incongruity and his anomalous binocular spatial localization will now be considered.

Three types of information can be obtained by means of the space eikonometer with regard to a subject's anomalous spatial localization (aniseikonia):

(1) The appearance to the subject of the elements of the target of the space eikonometer when the adjustable size units are set at zero; that is, are not introducing magnification (size differences).

(2) The nature and magnitude of the magnifications that have to be introduced by means of the size lenses to cause the elements of the target to appear in their proper positions.

(3) The degree of accuracy with which a subject binocularly localizes the various elements of the target, as shown

by the spread of his settings of the adjustable size units when magnifications are introduced to cause the elements of the target to appear in their proper positions.

The general procedure for obtaining this information is as follows:

The subject, wearing his distance refractive correction (if ametropic) in a trial frame or spectacles, is seated before the instrument with his head properly positioned in the headrest. The examiner adjusts the test lens units for interpupillary position and makes certain that the subject can see both of the front green plumb cords with each eye.

It is then explained to the subject that this is a test involving binocular space perception and that the test elements of the instrument will be seen to change their positions during the different parts of the test when certain lenses are used and that he (the subject) will be asked to make accurate judgments as to their relative distances and positions. While the examiner calls attention to the test elements and their behavior, he gradually changes the size of the image of one eye and then that of the other by means of the adjustable size units, first in the horizontal meridian (axis 90° unit), then in the vertical (axis 180° unit), and then in oblique meridians (geared lens unit). This series of changes in image size with the corresponding changes in apparent orientation of the test elements serves both to acquaint the subject with the nature of the test and to arouse his stereoscopic perception. (It is well to bear in mind that aniseikonic patients frequently have binocular fusion difficulties and may be relatively insensitive to stereoscopic clues.)

The adjustable size units are then set at "zero" and the subject is questioned as follows: "Do the two front green cords appear the same distance from you or is one nearer? If one is nearer, which one—the right or left?" "Does the cross, when considered as a whole, appear rotated about the central white cord, with one side nearer to you than the other, or are the two sides at the same distance from you?" If they are not at the same distance, the subject is instructed to estimate whether the apparent rotation is equal, greater, or opposite in direction to the apparent rotation of the two front green cords. "Does the cross, when considered as a whole, appear to be vertical, or is it inclined with the top toward or away from you?"

The subject's answers to these questions may be entered on the data sheet as a qualitative record of the nature of his anomalous localization.

Using the same form of questioning, the examiner then proceeds to determine the magnitude of the false orientation of the test elements in terms of the image size difference (magnification) which it is necessary to introduce to correct the false orientation. The basic principle to be observed is to measure and correct the size difference in the horizontal meridian (axis 90° unit) before proceeding with the measurement of the vertical size difference.

Axis 90° measurements (image size differences in the horizontal meridian). The subject is instructed to report which of the two front vertical cords appears nearer—the right or the left. If the right cord appears nearer, magnification is introduced in the adjustable size unit (axis 90° unit) before the right eye until it is reported that the cords are equidistant. If the left cord is reported to be nearer, the image size in the left eye is increased in the horizontal meridian.

The rule, then, in making axis 90° determinations, is to increase the magnification before the eye corresponding to the nearer cord. The nearer cord will be on

the side of the eye having the smaller ocular image (in the horizontal meridian).

At this point the accuracy, or sensitivity, of the subject's discrimination can be checked by determining how much magnification, more or less, can be introduced before the lines no longer appear equidistant.

For convenience and consistency, all measured image incongruities (axis 90°, axis 180°, and oblique), should be recorded in terms of the magnification of the size lenses which is necessary to correct the false appearances of the test elements. Thus, R. 3.00% ±0.25% ax. 90° means that a 3.00 percent meridional size lens at axis 90° before the right eye was necessary to make the two front vertical cords appear the same distance from the observer and that the observer could discriminate this difference with a sensitivity of ±0.25 percent. Of course, the left ocular image is actually 3.00 percent larger in the horizontal meridian. For comparison with the subject's symptoms and performance, however, it is usually better to think in terms of which of the ocular images is larger or smaller, instead of in terms of the correction.

Axis 180° measurement (size differences in the vertical meridian). With the axis 90° size correction in place, the subject is now instructed to report which side of the cross appears nearer to him —the right or the left. If the right side of the cross appears nearer, magnification is introduced in the vertical meridian (axis 180° size unit) before the left eye until both sides of the cross are reported to be equidistant. If the left side of the cross is reported nearer, the magnification must be increased in the axis 180° unit before the right eye.

The rule, then, in making axis 180° measurements is to increase the magnification before the eye corresponding to the farther side of the cross. The nearer side of the cross will be on the side of the eye having the larger ocular image (in the vertical meridian).

The accuracy of the subject's judgment can be determined in the same manner as described in the preceding section.

The presence of a vertical phoria will frequently change the appearance of the cross in such a way that the two oblique cords do not appear to intersect, one of the cords appearing closer to the subject than the other. In this event it is necessary to correct the vertical phoria by means of prisms before making the measurements.

An overall difference in the size of the ocular images occurs when, in the absence of an oblique error, the axis 90° and axis 180° corrections before one eye are found to be equal.

Measurements to determine the image size differences in oblique meridians. With both the horizontal and vertical size differences corrected, the subject is instructed to report whether the top of the cross appears to tilt toward or away from him. If the top is reported to tilt forward, the geared lenses are rotated toward the minus side of the scale (axes converging down) until the cross is reported to be vertical. If the top of the cross is reported to tilt away from the subject, the geared lenses are adjusted to the plus side of the scale (axes converging up) until the cross is reported to be vertical.

The accuracy of the subject's discrimination can be checked by determining the limits in degrees of rotation of the geared lenses within which the cross is reported to be vertical.

At this point the axis 90° and axis 180° findings should be rechecked. This is done to eliminate the possible influence of the apparent position of the cross upon the cords, and vice versa. The subject should then be questioned as to whether

the elements of the target as a whole appear correctly oriented.

Ordinarily for prescription purposes, it is sufficient to designate the correction in terms of the axis 90° and axis 180° findings in percent magnification and the oblique findings in terms of degrees of rotation of the geared lenses. From these data the lens designer can determine the aniseikonic correction.

It is worth while, in the test, to determine the equivalent prescription of meridional size lenses which corrects the axis 90°, axis 180°, and oblique incongruities as determined by the foregoing procedure. For this purpose, a series of tables have been computed.[6] When this equivalent correction is found, the indicated size lenses may be placed before the eyes. The adjustable size units and the geared lenses are then set back to "zero" and the subject is instructed to report on the appearance of the target elements. If the data and equivalent lens combination have been determined correctly, the equivalent lenses should correct the ocular incongruities present, and all of the elements of the target should appear properly oriented.

Irregular and asymmetric incongruities. Thus far, only regular, systematic ocular incongruities have been considered. There is evidence, however, that irregular incongruities, which may be due either to anomalous dioptric conditions or an anomalous anatomic organization of the retinal elements, are not uncommon and can exist in combination with one or more types of regular ocular incongruities. For instance, the ocular image from the right eye may be larger than that from the left in the horizontal meridian at one angular distance and smaller at another. The presence of such irregular incongruities does not make itself apparent in the appearance of the elements of the space eikonometer. It may result, however, in a decreased sensitivity and in the inability to perceive any or the proper amount of displacement of the elements of the target when artificial incongruities are produced by means of size lenses. No means of measurement or correction of such incongruities are available as yet.

Another type of aniseikonic error which may be more or less systematic in character is that produced by an anomalous asymmetric incongruity of the two ocular images. One form, not infrequently encountered, is an anomalous horizontal incongruity of the two ocular images where the images from the nasal sides of the retinas are greater than those from the temporal side (that is, temporal field larger than nasal). To the observer with such a condition a flat surface situated normal to him, may appear to be convex toward him or flat and nearer. If the asymmetric incongruity is greater temporally than nasally, the surface may appear either concave or flat and farther away. At present, methods of determination and correction of this type of incongruity are being studied.

Asymmetric incongruity can be in meridians other than the horizontal meridian and in one eye only. Such types of anomalous asymmetric incongruity make themselves apparent in the anomalous appearances of the elements of the cross, as when one or more of the arms are tilted backward or forward from the plane of the cross. The exact nature of these types of asymmetric incongruity requires further study.

Discussion

The space eikonometer has been in daily use in the Clinical Division of the Dartmouth Eye Institute since July, 1941. During this time it has been possible to evaluate the test from the standpoint of practical clinical application.

Quite early in the investigations it was

established that a high correlation existed between the measurements of aniseikonia obtained with the standard eikonometer and those obtained by anomalous space perception on the space eikonometer.[7]

This actually should be interpreted as a validation of the principle of the standard eikonometer procedure, since anomalous binocular space perception can be accounted for only in terms of image size differences and not in terms of anisophoria or differential fusional movements of the eyes as has been suggested[8] with regard to the standard eikonometer findings.

Clinical experience has shown that, in general, the space-eikonometer-test procedure consumes considerably less time and provides an easier discriminative task for the patient than does the standard eikonometer procedure. Such factors as fixation disparity, phoria variability, and poor fixation ability, which make discrimination a difficult task for many patents during the latter test, do not enter into the space eikonometer test to complicate the procedure. Certain exceptions exist, however. Patients who have binocular vision but no stereopsis can usually be handled more satisfactorily with the standard eikonometer.

It must be emphasized, however, that the ordinary tests for stereopsis do not provide criteria for determining whether the patient may or may not be measured on the space eikonometer. Individuals with little or no central (axial) stereopsis can be measured on the space eikonometer with considerable accuracy provided they manifest peripheral stereopsis.

Over and above these obvious practical advantages the space eikonometer provides a means for determining meridional aniseikonia at oblique axes. It should be pointed out here that the majority of cases with astigmatism at oblique axes can be expected to demonstrate a measurable amount of this form of aniseikonia.[9] Cases have been studied in which the full astigmatic (oblique) correction could be tolerated only when the associated aniseikonia was also corrected.[10] It is common clinical experience to have patients with astigmatism at oblique axes report various distortions of their environment following correction of their refractive error. With constant wearing of the correction these distortions often disappear after a few days. It has been customary to assume that their disappearance represented simply an adaptation to the new correction.

It must be borne in mind, however, that the usual surroundings contain an abundance of uniocular clues to spatial orientation (rectilinear perspective, size, brightness, shadows, familiar forms, and the like) to which the individual may respond. That he does so is evidenced from the fact that even after "adaptation" has taken place, the spatial distortions immediately become manifest when he is placed in surroundings lacking in uniocular clues.[4] Such surroundings may be natural, as in the woods, open country, or on the water, or artificial, as in the environments provided by aniseikonic test apparatus in which they can be measured. Unless the aniseikonic errors are corrected there remains, in spite of this "adaptation" to normal surroundings, a basis for conflict between the responses to the uniocular and binocular clues which can be troublesome and productive of further symptoms. The "adaptation," then, simply means that the patient is not utilizing binocular vision with full efficiency, but is disregarding binocular stereoscopic clues and relying predominantly upon uniocular clues for spatial orientation.

From such considerations it may be concluded that interpretation of the nature of the patient's anomalous spatial

localization provides a basis for a clearer understanding and evaluation of the patient's symptoms in terms of his actual function and performance. From the point of view of efficiency of function, in so far as there is any disregarding or suppression of the binocular stereoscopic clues, the accuracy of the patient's binocular spatial localization is, to that extent, impaired.

It should be emphasized here that this impairment represents, in essence, a lack of correspondence between the visual localization and the actual location of the external environment. Considered from the standpoint of stimulus-response relationships and the role of sensory impressions as determinants of behavior, this clearly becomes a matter of broad, general significance. The inadequacies and errors in performance resulting from such lack of correspondence can have a profound effect upon the individual in providing a basis for conflicts and frustrations. The nature and severity of the effects vary with the individual and are conditioned by such factors as the nature of his visual environment, the nature of the visual requirements of his occupation, his general motivation, and his health. Thus, not only do our concepts of the functional aspects of aniseikonia become clarified but an analytic approach is indicated which should be helpful to the clinician when utilized in diagnosis and considerations of therapy.

Dartmouth Eye Institute.

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PERFORATING OCULAR INJURIES*

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This report is based on a study of the records of 172 cases of perforating ocular injuries of patients who were admitted to the wards of the Wilmer Ophthalmological Institute during the years 1935 to 1942, inclusive.

The selection of these 172 cases was made from a total of approximately 275 both public and private ward patients. Some records were discarded either because they were incomplete or because there was an inadequacy of postoperative follow-up observation. Also discarded were the records of all patients with perforating ocular injuries who had received definitive treatment before coming to the hospital, or in whom examination had been so long postponed that the outcome was determined before treatment could be instituted. The study does not include nonperforating injuries, or cases of subconjunctival scleral rupture. Cases of retained intraocular foreign bodies are included. Of the 275 records which were reviewed, 47, or 17 percent, were discarded because enucleation was performed without any attempt being made at repair, it being considered that the eyes were hopelessly lost. Figures including these 47 enucleated eyes, however, appear later in the discussion of the influence of the length of the laceration on recovery, and in the computation of the incidence of sympathetic ophthalmia.

In this study there are no rigid specifications of minimal postoperative observation; thus there are included all records in which it seemed reasonably certain that the visual acuity had reached its final level at the time of the last recorded examination. This method of selection may have led to the occasional inclusion of a case as a "successful" result which may later have developed serious complications. On the other hand, there are included a few cases in which further operative treatment (for example, discission or capsulectomy) might have produced an improvement of the final visual acuity.

Applying these methods of selection, there are available for review the records of 172 cases of recent perforating ocular injuries, in each of which an attempt was made to save the eye.

The cases were analyzed and, as far as possible, studied statistically in the attempt to illuminate the following problems:

A. What average degree of success was achieved?
B. What are the principal complications that influence the outcome?
C. What are the best methods of management?

Each of these items is discussed below under separate headings.

AVERAGE DEGREE OF SUCCESS

The degree of success expressed in final visual acuity achieved in the treatment of these injured eyes is given in table 1. Fifty-two patients, or 30 percent, regained a corrected visual acuity of 20/40 or better. (There are 12 cases in which the visual acuity could not be measured because the patients were too young to coöperate. In these cases the final examination disclosed nothing that should interfere with visual acuity. These cases are included in the 20/100 column in all tables.) In 47 cases the end result was loss of all light perception, enucleation

*From the Wilmer Ophthalmological Institute of the Johns Hopkins Hospital and University. Presented in part before the New York Academy of Medicine, Section of Ophthalmology, Dec. 20, 1943.

TABLE 1

OUTCOME AS TO VISUAL ACUITY WITH CORRECTION—172 CASES

Visual Acuity	20/20 to 20/40	20/50 to 20/100	20/200 to 10/200	9/200 to 1/200	Light Projection	Light Perception	Blind
Number of each	52	34*	7	18	5	9	47**
Percent	30	20	4	11	3	5	27

* Includes 12 cases in which the visual acuity could not be measured.
** 44 of these were enucleated.

being performed in 44 of these. There remain 39 cases in which the final visual acuity varied from 20/200 to the ability to perceive light. In this series, the visual-acuity figure is an accurate index of the usefulness of the injured eye, there being no case in which there was extensive loss of the visual field without associated reduction of central vision.

Thus, in the treatment of the 172 cases of perforating ocular injuries, 50 percent of the patients achieved a final visual acuity of 20/100 or better, and 50 percent of 20/200 or worse.

THE INFLUENCE OF COMPLICATING FACTORS

In perforating ocular injuries there are numerous factors and complications that may influence the final visual outcome. A complete study of the role and the interrelationship of each of these numerous possible variables in the course and outcome of such injuries is impossible in a clinical series of this size. Nevertheless, it is important to break down the over-all figures in a study of the role of a few factors which, on the basis of general experience, are presumed to be important. This has been done for the following factors and complications: (1) the age of the patient, (2) the agent causing the injury, (3) the length of the laceration, (4) the location of the laceration, (5) the degree and nature of prolapse of intraocular contents, (6) the degree of damage to the lens, (7) the degree of intraocular hemorrhage, (8) the occurrence of infection, (9) the occurrence of sympathetic ophthalmia, and (10) the presence or absence of retained intraocular foreign bodies.

(1) *Age.* The age distribution for the 172 cases analyzed is shown in table 2. The patients of 40 years or over are grouped together because of their relatively small number. In this table there are no striking variations in the average levels of visual acuity achieved in the various age groups, except that the figure of 36 percent regaining 20/100 corrected vision or better for the group 40 years

TABLE 2

OUTCOME IN VISUAL ACUITY ACCORDING TO AGE

Age yrs.	No.	20/20 to 20/40	20/50 to 20/100	20/200 to 1/200	Light Perception	Blind	20/100 or Better, percent
0–4	18	1	7	—	1	9	44
5–9	31	13	3	5	1	10	50
10–19	47	17	4	10	1	11	51
20–29	24	8	6	4	3	3	58
30–39	27	10	5	—	4	8	54
40+	25	3	6	6	4	6	36

and over is lower than the average. For old individuals, it might be assumed that such factors as delay and imperfection in healing, or increased vascular fragility, or diminished resistance to infection contribute to a poorer average of satisfactory recoveries. However, in the 25 cases falling in the age group of 40 years or over, reopening of the wound or delay in re-formation of the anterior chamber occurred in three cases, unusual hemorrhage occurred in three cases, and intraocular infection occurred in four cases, with one

TABLE 3

OUTCOME ACCORDING TO THE AGENT CAUSING THE INJURY

Agent	No.	20/20 to 20/40	20/50 to 20/100	20/100 to 1/200	Light Perception	Blind	20/100 or Better, percent
Glass	43	16	13	4	4	6	67
Wood	27	12	4	3	2	6	59
Metal	63	15	13	9	4	22	44
Blunt	8	1	2	2	0	3	38
Gunshot	6	1	0	1	1	3	17
Miscellaneous, unknown	25	7	2	7	3	6	35

recovery. The incidence, for this age group, of each of the aforenamed complications is similar to that for the entire series (see below). The data do not show an influence of the age of the patient on recovery. The possible effect of senility cannot be determined because of the small number of older patients.

Recapitulation: The age of the patient is not demonstrated to have an influence on the outcome in terms of visual acuity. The data are inconclusive because of the limited number of persons of advanced age.

(2) *Agent.* The data as to the influence of the agent causing the injury on the final outcome are given in table 3. Lacerations caused by glass appear to have the best prognosis, most probably because such lacerations are usually very clean and straight, and are associated with relatively little maceration of tissue. The same principle apparently applies in this series to perforating injuries by wooden splinters.

The few instances of gunshot wounds indicate that this type of perforating ocular injury has a poor prognosis, undoubtedly because of the disorganization of the ocular tissues secondary to the explosive force of bullet impact, and the usual double perforation of the globe. Blunt injuries appear to carry a poor prognosis; often trauma from a blunt object (brick, fist, and so forth) ruptures the globe, owing to its explosive force. Moreover, a direct laceration from a blunt object is very apt to have ragged and macerated margins.

Recapitulation: The influence on the outcome of the agent causing the injury appears to be roughly proportional to the sharpness of the agent. Bullet wounds and blunt injuries carry a poor prognosis.

(3) *Length of laceration.* Table 4 shows the outcome in visual acuity following lacerations of various lengths. To eliminate some variables, there are included in table 4 only cases of corneal or of corneoscleral lacerations, and those of retained intraocular foreign bodies are excluded. Thus, it is seen in table 4 that when the visual results are grouped as better or worse than 20/100, there is no striking relationship between the length

of the laceration and the average outcome in terms of visual acuity. However, if the cases are grouped as better or worse than 20/40 visual acuity, it is seen that the number regaining normal or nearly normal vision falls off steadily as the length of the laceration increases. Evidently the longer the corneal scar the greater is the chance it will interfere with vision, even though healing proceeds satisfactorily in all other respects.

It must be realized that in this series a strong element of selection operates as far as the length of the laceration is concerned. The amount of organic damage done to eyes is often pertinent to the length of the laceration—in general, short lacerations tend to produce less organic damage than do long lacerations. Since the decision to enucleate or not to enucleate an injured eye is based on the clinical picture and the amount of organic damage produced by the injury, in general, eyes that have long lacerations are enucleated more frequently, no attempt being made at repair, than are eyes with short lacerations. Thus of the 47 eyes enucleated immediately, without attempt to repair, 80 percent had lacerations of 8 mm. or over. This automatic exclusion of a great number of eyes with long lacerations, weights the figures in this study in favor of short lacerations.

With due allowance for these limitations, the data concerning the influence of the length of the wound on the final outcome demonstrate the following points:

First, lacerations of 1 to 4 mm. in length are nearly as dangerous as lacerations of 5 to 8 mm.

Second, there are several instances of recovery from lacerations over 8 mm. in length, which demonstrates that satisfactory healing may occur in the presence of long lacerations. (On the other hand, there is every reason to believe that a great majority of the eyes with long lacerations which were enucleated immediately would not have healed satisfactorily had repair been attempted.) On the basis of these observations, it is reasonable to assume that it is such factors as the degree of the explosive force of the blow or of the severity of intraocular hemorrhage that are the determining factors, and the actual length of the laceration is only incidental.

Recapitulation: No correlation is demonstrated between the length of the laceration and the percentage of satisfactory recoveries for wounds under 9 mm. in length. The data are severely influenced by the tendency to enucleate immediately nearly all eyes that have sustained a long laceration.

(4) *Location.* In table 5 are presented the data on the outcome correlated with the location of the laceration. Forty-seven

TABLE 4

OUTCOME ACCORDING TO THE LENGTH OF THE LACERATION*

Length mm.	No.	20/20 to 20/40	20/50 to 20/100	20/200 to 1/200	Light Perception	Blind	20/100 or Better percent	20/40 or Better percent
1 to 2	22	11	1	3	1	6	55	50
3 to 4	35	15	8	6	2	4	66	43
5 to 6	23	6	6	6	—	5	52	26
7 to 8	24	5	7	2	—	10	50	21
9 and over	14	2	4	—	4	4	43	14

* Corneal or corneoscleral lacerations only, excluding cases with retained intraocular foreign bodies.

TABLE 5

OUTCOME ACCORDING TO THE LOCATION OF THE LACERATION

Location	No.	20/20 to 20/40	20/50 to 20/100	20/200 to 1/200	Light Perception	Blind	20/100 or Better, Percent
Cornea	114	35	19	20	7	33	47
Ciliary body	15	8	1	4	0	2	60
Cornea and Ciliary body	31	8	10	1	3	9	58
Sclera	6	2	2	—	1	1	67
Double perforation	6	—	1	1	2	2	17

percent of the eyes in which the laceration was confined to the cornea achieved a visual acuity of 20/100 or better. Involvement of the sclera in the region of the ciliary body, with or without extension into the cornea, does not have an adverse influence, since 58 percent of eyes with such lacerations regained visual acuity of 20/100 or better. Perforating lacerations posterior to the ciliary body are less frequent, occurring only six times in this series, and no conclusions can be drawn as to the relative seriousness of such injuries. Double perforations of the globe apparently rarely heal with retention of useful vision, although the number of such cases is so small the data are of no statistical significance.

Recapitulation: The location of the laceration is not demonstrated to have an effect on the average of successful recoveries. A double perforation of the globe appears to have an unfavorable effect.

(5) *Prolapse.* The disorganization produced in the eye by severe degrees of prolapse of the intraocular contents is so obvious that it needs no further discussion. When serious degrees of prolapse are met with in perforating ocular injuries, the picture is so evidently hopeless that it is only exceptionally that any attempt at repair is undertaken. The effect of major degrees of prolapse is agreed to be devastating and needs no further demonstration. It is, however, of interest to assess the not-so-obvious influence of minor degrees of prolapse.

Prolapse of the iris in a corneal laceration has often been regarded as a natural defense mechanism against infection. Is this concept in accord with the findings for this series? There are in this series 145 cases of corneal laceration, including those extending into the sclera. Prolapse of iris or ciliary body occurred in 91 of these cases; and in 54 there was no prolapse of iris or ciliary body. Of the 91

TABLE 6

THE EFFECT OF PROLAPSE OF IRIS UPON THE DEVELOPMENT OF INFECTION

Iris Involvement	Lens Damaged		Lens Intact	
	No.	% Infected	No.	% Infected
Prolapsed	38	21	53	3.8
Not prolapsed	33	33	21	19

eyes in which prolapse of iris or ciliary body occurred, 12, or 13 percent, developed an intraocular infection. Of the 54 uncomplicated by prolapse, 15, or 28 percent, developed an intraocular infection (table 6). The figures suggest that the incidence of infection complicating corneal wounds is reduced by the presence of a prolapse of the iris. However, since there is a correlation between infection and injury of the lens, the incidence of lens damage is also shown in table 6. Again, there is an apparent antiseptic effect of prolapse of the iris, but the figures fall short of statistical value.

TABLE 7

OUTCOME ACCORDING TO THE OCCURRENCE OF PROLAPSE OF IRIS*

Iris Involvement	No.	Average Length mm.	20/100 of Better, percent	Blind, percent
Prolapsed	60	5.1	60	15
Not prolapsed	28	4.5	71	11

* Corneal or corneoscleral lacerations, not infected, excluding cases with intraocular foreign bodies.

It remains to be seen if prolapse of the iris has any further significance as regards recovery from corneal wounds. In an effort to isolate as much as possible the role of prolapse of the iris, those cases complicated by infection or by retained intraocular foreign bodies were for the moment discarded. This left 88 cases of corneal or corneoscleral lacerations, in 60 of which there was prolapse of iris, and in 28 no prolapse. Table 7 indicates that recovery of vision is little influenced by the occurrence of prolapse of the iris, in the absence of infection.

Prolapse into a corneal wound of lens material with or without uveal tissue occurred 10 times. Six of these eyes ultimately were removed, and only one regained visual acuity of 20/100 or better. These figures may not be significantly different from those given in table 8, which shows the degree of success achieved in the presence of injury to the lens, with and without prolapse of lens substance.

Recapitulation: Prolapse of the iris in a corneal laceration is not observed to influence the outcome; its occurrence is not demonstrated to be associated with a reduced incidence of infection, although there is suggestive evidence of such an effect.

(6) *Lens damage.* The data showing the influence of damage to the lens in perforating ocular injuries are given in table 8. Of 73 eyes in which the lens remained intact, 75 percent regained a final corrected visual acuity of 20/100 or better, and 14 percent eventually came to enucleation. On the other hand, of 56 eyes in which the lens was either punctured or ruptured, 29 percent recovered a corrected visual acuity of 20/100, and 45 percent were ultimately enucleated. There remains a group of 18 cases in which there were either small, localized lens opacities which did not progress, or in which lens opacification developed late in

TABLE 8

OUTCOME ACCORDING TO THE OCCURRENCE OF INJURY TO THE LENS*

Lens Involvement	No.	20/100 or Better percent	20/200 or Worse percent	Blind percent
Lens intact	73	75	25	14
Lens injured	56	29	71	45
Stationary or late lens changes	18	55	45	11

* Cases with intraocular foreign body excluded.

TABLE 9

ENUCLEATED EYES
CHIEF FINDINGS ON MICROSCOPIC EXAMINATION

Lens Involvement	Disorganized Globe	Sympathetic Ophthalmia	Massive Hemorrhage	Nonspecific Uveitis	Purulent Endophthalmitis	Phthisis Bulbi	Retinal Detachment
Lens intact, 9 cases	1	2	1	1	1	2*	1
Lens injured, 28 cases	3	—	2	7**	12	4	—

* Both had had clinical evidence of intraocular infection.
** Includes 3 cases with previous clinical evidence of infection.

the period of observation, presumably because of some secondary influence. Those cases involved by intraocular foreign bodies are not included.

These data indicate a malignant effect of traumatic cataract in cases of perforating ocular injuries. They raise the question of how a pathogenetic effect is exercised by the damaged lens. This problem was attacked first, by a study of the causes of reduction in visual acuity in eyes removed, comparison being made in each instance of the eyes that had suffered lens damage with those in which the lens was uninjured.

The histologic findings of the enucleated eyes are given in table 9. To reduce the number of possible variables, cases complicated by an intraocular foreign body are excluded. In comparing the findings according to the presence or absence of lens injury, two important differences stand out: First, the number of eyes lost through infection, and, second, the incidence of posttraumatic uveitis are both greater among those eyes which received damage to the lens. The question of infection is discussed more fully below. However, attention is here called to table 13, which shows the incidence of purulent infection for the entire series, and its much more frequent occurrence among cases complicated by injury to the lens.

Turning aside for the moment from the question of purulent infection, it was noted in the foregoing account that the occurrence of posttraumatic uveitis appeared to be favored by the presence of damage to the lens. To determine to what extent lens damage could be responsible for this posttraumatic uveitis, comparison of the incidence of posttraumatic uveitis in retained eyes, in the presence and in the absence of lens damage, was made, and is shown in table 10. Since the role of purulent infection has already been demonstrated, all instances of clinical evidence of infection are omitted in table 10, which refers only to corneal and corneoscleral lacerations, cases in which there were intraocular foreign bodies also being excluded in an effort to isolate the variable under consideration. It is seen that posttraumatic or postoperative uveitis occurred in 12 of 31 cases in which there was traumatic cataract, and occurred in no instance among those 78 cases in which the lens was intact (including cases with nonprogressive lens opacities or with late lens changes). The classification of uveitis phaco-anaphylactica rests upon the demonstration of an abnormal skin sensitivity to lens protein on intracutaneous injection. One instance of uveitis was almost certainly sympathetic ophthalmia, as demonstrated by a granulomatous uveitis of the second eye coming on 14 weeks after injury, in association with a positive skin test for uveal pigment. The occurrence of uveitis contributed to a reduction in visual acuity in a number of cases (table 11). Perhaps a more serious attribute of the complication is that it suggests the danger of sympathetic ophthalmia and encourages enucleation. In this way, a relatively benign posttraumatic iritis may cause the loss of an eye which otherwise might have recovered.

TABLE 10

INCIDENCE OF POSTTRAUMATIC UVEITIS*

Lens Involvement	Non-specific Uveitis	Uveitis Phaco-anaphy-lactica	Sym-pathetic Oph-thalmia
Lens intact, 62 cases	0	0	0
Stationary or late lens changes, 16 cases	0	0	0
Lens injured, 31 cases	9	3	1

* Excluding instances of purulent infection, or of intraocular foreign bodies, and not including enucleated eyes.

It is thus seen that the complication of injury to the lens contributes to unsatisfactory healing in two respects: It in-

creases the incidence of purulent intraocular infection, and it increases the incidence of posttraumatic uveitis. It remains to be seen if these sources of failure comprise in full the pathogenetic effects of the damaged lens. With this end in view, table 11 has been constructed, giving the cause for reduction of vision (below 20/40) in surviving eyes, again excluding cases complicated by infection or by retained intraocular foreign bodies, and including corneal or corneoscleral lacerations only. In table 11, the increased incidence of visual failures among cases presenting an injured lens is accounted for almost completely by two factors; first, by several instances of post-iritis changes (synechiae, occluded pupil, cyclitic membrane, and the like) sufficient to cause reduction of vision; and secondly, by opacities derived from the remains of incompletely removed traumatic cataract.

On the whole, there are three reasons why injury to the lens is associated with such a less-favorable, average outcome—incomplete removal of a traumatic cataract, and the complications that follow either a purulent infection or a posttraumatic uveitis. If these complications do not develop, the chances of recovery of vision in perforating ocular injuries are equally good regardless of the occurrence of traumatic cataract.

Recapitulation: Injury to the lens exerts an adverse influence on the final visual outcome. Its principal deleterious role lies in the tremendously increased incidence of purulent infection and of posttraumatic uveitis. In the absence of these complications, injury to the lens does not influence the prognosis for recovery of vision.

(7) *Hemorrhage.* Minor degrees of hemorrhage into the anterior chamber or into the vitreous were not demonstrated to have any relation to the final visual outcome. For the sake of simplicity these data are omitted. There are 18 cases in this series in which severe intraocular hemorrhage was devastating. Three of these cases were further complicated by an intraocular infection, leaving 15 cases for analysis.

Of the 15 uninfected eyes which sustained severe intraocular hemorrhage, 8 were eventually enucleated. One of these developed sympathetic ophthalmia, and it is possible that hemorrhage may have had some influence on the outcome, since a severe intraocular hemorrhage, occurring on the third postoperative day, resulted in secondary glaucoma, which was treated by lavage of the anterior chamber. Two cases showed, in addition to the hemorrhage, a subacute inflammatory reaction that kept the eyes dangerously irri-

TABLE 11

CAUSE FOR REDUCTION OF VISUAL ACUITY*

Lens Involvement	Visual Acuity 20/40 or Better	Visual Acuity Reduced to 20/50 or Worse by:						
		Corneal Scar	Post-iritis Changes	Capsular Remains	Vitreous Opacities	Retinal Damage	Phthysis Bulbi	Cause Uncertain
Lens intact, 62 cases	42	9	—	—	3	2	1	5
	68%	14.5%	—	—	5%	3%	1.5%	8%
Lens injured, 31 cases	9	6	4	8	—	—	2	2
	29%	19%	13%	26%	—	—	6.5%	6.5%

* Corneal or corneo-scleral lacerations, not infected, without intraocular foreign body.

tated for several days after repair, so that they were enucleated as potentially sympathicogenic. One of these two had sustained a through-and-through injury from a knife, and a cilium was discovered in the posterior wound. Two others were in phthisis at the time of enucleation. In the sixth case there was a badly disorganized globe. In the remaining two, there was massive subretinal hemorrhage; one of these eyes was enucleated because of a painful secondary glaucoma and another because it failed to clear after repair and was considered potentially dangerous.

Of the seven eyes that sustained severe intraocular hemorrhage and were not enucleated only one recovered useful vision. Three developed phthisis bulbi. None of these three received any second operation which might have contributed an added insult. In two, haziness of the vitreous persisted and reduced vision to light perception with accurate projection. One of these had a through-and-through laceration, evidenced by roentgenographic demonstration of a foreign body in the orbit. The other had a short corneal laceration without evidence of damage to the lens, in which a severe vitreous hemorrhage did not clear in 70 weeks. In one a cyclitic membrane developed across the pupillary space.

These cases illustrate well three disastrous effects of intraocular hemorrhage. In the first place, hemorrhage has a tremendous disorganizing effect, dislocating the intraocular contents and often sweeping them out through the laceration, as in an operative expulsive hemorrhage. Secondly, intraocular hemorrhage has an irritative effect, exciting an inflammatory response which is always alarming, and occasionally ends with the formation of a cyclitic membrane and phthisis bulbi. In the third place, for little-understood reasons, hemorrhage in the anterior chamber instead of becoming absorbed may proceed to organization, with the formation of heavy scars obliterating the pupil and the chamber angle, and in the vitreous chamber may produce destruction of the retina and detachment.

Intraocular hemorrhage is, in all likelihood, frequently responsible for the quiet passing into phthisis of many injured eyes whose original appearance had encouraged optimism. An inconspicuous posterior-chamber hemorrhage, for example, may give rise to a low-grade iritis, or may organize and initiate a cyclitic membrane; or an overlooked choroidal hemorrhage may end in retinal detachment, and so forth.

Recapitulation: It is evident that severe intraocular hemorrhage is usually recognizable clinically, and produces such a serious picture that the eyes are often promptly removed. The outlook for recovery of vision in those that are treated surgically is poor, for the following reasons: (a) The disorganizing effect of intraocular hemorrhage, (b) the irritating effect of and inflammatory reaction to hemorrhage, and (c) the occasional tendency of hemorrhage to organize.

(8) *Infection.* Microscopic examination of the 44 enucleated eyes showed positive evidence of intraocular infection in 17, the largest single pathologic finding in the group of enucleated eyes. In nine other cases, definite clinical evidence of infection was present, although histologic proof was lacking because enucleation was not performed (five cases), or because the process had passed through the stage of purulent inflammation by the time of enucleation (four cases).

The clinical evidence for the presence of infection in the nine cases wherein histologic demonstration was lacking is as follows: Of the five eyes which were not enucleated, two had a corneal abscess at the site of the perforation with hypopyon; one had frank pus in the anterior chamber; and the other two had clinical evidence of a less severe purulent intraocu-

lar reaction. Of the four eyes which were removed after passing through the stage of purulent reaction, one had a hypopyon of the anterior chamber and B. subtilis was cultured from the discharge before repair; one was described as "a severe intraocular infection," and B. coli was cultured clinically; one was described as "grossly infected," with a heavy growth of Staph. aureus on culture, and the fourth had purulent exudate in the anterior chamber, with a heavy growth of Staph. aureus on culture. On pathologic examination of these four eyes after enucleation, three showed subacute intraocular inflammation, not purulent in type, and similar to that occurring in untraumatized eyes with severe uveitis. The sections of the eye from the fourth case showed phthisis bulbi with a cyclitic membrane, and practically no active inflammation.

The subsidence of an acute purulent endophthalmitis without perforation and the progress of the eye into phthisis is, of course, an old observation. It is further exemplified in this study by two other cases. In both of these iridectomy was performed at the height of the inflammation and the biopsy specimen from the iris showed acute purulent inflammation. The eyes later came to enucleation and both showed phthisis bulbi with little active inflammatory residue.

Seven of the 44 enucleated eyes showed, on the microscopic sections, a subacute type of intraocular infection, although there was no clinical nor bacteriologic evidence of purulent inflammation. Since there is no way of determining with certainty whether these eyes were the site of a traumatic uveitis or a low-grade infection, these eyes cannot be classified as "infected," although this etiology cannot be ruled out.

The incidence of infection in the entire series of 172 cases was 26 cases, or 15.1 percent. Among the 47 eyes which were enucleated after the first examination without any attempt at repair or treatment, purulent endophthalmitis was present in 11. The incidence of infection for the total 275 injured eyes from which the material was selected was 40, or 14.5 percent.

The seriousness of infection complicating penetrating injuries is shown in the fact that of the 26 cases in which this diagnosis was made clinically or pathologically all but 5 eyes were enucleated. Of the five eyes that were retained, one ended with loss of all light perception. In the remaining four eyes, all of which recovered good vision, two had corneal abscess with hypopyon. While the clinical picture indicated that infection actually was present within the eye, it is possible that in these cases the infection was restricted to the cornea and the intraocular contents were not invaded. Of the two eyes in which recovery from a clinically diagnosed purulent endophthalmitis occurred, both received intensive therapy, one with sulfathiazole and one with sulfapyridine. Thus, of the 26 eyes in which the diagnosis of purulent endophthalmitis was made, 22 lost all vision, and 4, or 15 percent, regained 20/40 vision or better.

The influence of the sulfonamides in the treatment of intraocular infection following penetrating injuries is shown in table 12. Thirteen patients received intensive treatment by the oral use of one of the sulfonamides, and of these three recovered. Thirteen others were not so treated, and of these one recovered. These data indicate that the sulfonamides, while probably of great value in a few cases, are on the whole unsatisfactory in the treatment of intraocular infections complicating penetrating ocular injuries.

There is long-standing, well-documented evidence that lens cortex acts as an

TABLE 12

SULFONAMIDES IN THE TREATMENT OF PURULENT INTRAOCULAR INFECTIONS FOLLOWING PENETRATING INJURIES

Drug	No.	Days from Injury to Onset of Treatment	Duration of Treatment, days	No. with Lens Damage	Enucleated	Recovered
Sulfanilamide	1	3	4	1	1	
Sulfapyridine	3	3	10	2	2	1
Sulfathiazole	7	1 to 5	5 to 21	7	6	1
Sulfadiazine	2	1, 3	10	1	1	1
TOTAL TREATED	13			11	10	3
NO SULFONAMIDE TREATMENT	13			9	11	1

excellent culture medium for bacteria of all degrees of virulence, and that damage to the lens in a perforating ocular injury greatly enhances the occurrence of intraocular infection. The findings in this study are in no way at variance with this principle, as shown in table 13. Of the 26 eyes in which the diagnosis of purulent inflammation was made, 20 sustained damage to the lens and 6 did not. Conversely, for the whole series without regard to the presence or absence of other complicating factors, 78 eyes received damage to the lens and 26 percent of these were infected, while 94 had no damage to the lens, and of these only 6 percent were infected.

Fifty-six of the patients in this study received either sulfathiazole or sulfadiazine as a prophylactic measure. The oral use of the sulfonamide was begun immediately on admission of the patient to the hospital, although there was no evidence of infection. Of these 56 eyes, 6, or 10.7 percent, subsequently developed a purulent endophthalmitis. In five of these six cases, use of the drug was begun within 24 hours after injury; in the other, 40 hours after injury.

One hundred sixteen patients received no such "prophylaxis" against infection. Twenty of these, or 17.2 percent, subsequently developed a purulent endophthalmitis. These figures do not demonstrate that any marked benefit is obtained from the routine oral use of a sulfonamide in every case of penetrating ocular injury, the observed difference not being significant statistically. On the other hand, modern concepts of infection lead to the supposition that, in a given instance, the occurrence of infection depends on the balance between the resistance of the host and the number and virulence of the invading organisms. In a situation where these opposing forces are closely balanced, the use of any chemotherapeutic agent may well decide the outcome. The data given imply no argument against the prophylactic use of sulfonamides, and the routine use of chemotherapeutic agents, both in prophylaxis and as therapy, will, in all probability, save at least a small number of eyes which otherwise would be lost.

TABLE 13

INFLUENCE OF DAMAGE TO THE LENS AND THE ROLE OF PROPHYLACTIC SULFONAMIDES IN THE DEVELOPMENT OF INFECTION

Drug	Lens	No.	No. Infected	Percentage of Totals
None	Intact	66	6	
	Injured	50	14	17.2
Sulfathiazole	Intact	14	1	
	Injured	20	4	
Sulfadiazine	Intact	14	—	
	Injured	8	1	10.7
ALL CASES		172	26	15.1

It has been mentioned that postoperative uveitis may be occasionally related to infection. It is therefore of interest to learn if the use of a sulfonamide influences the incidence of uveitis. Table 14 shows that after the exclusion of those cases diagnosed as purulent intraocular infection, the "prophylactic use of the sulfonamides did not influence the occurrence of posttraumatic uveitis.

TABLE 14

THE ROLE OF PROPHYLACTIC SULFONAMIDES IN THE DEVELOPMENT OF UVEITIS*

Prophylaxis	Posttraumatic uveitis	
	No.	Percent
Sulfathiazole or sulfadiazine, 50 cases	9	18
No sulfonamide, 96 cases	17	17.7

* Instances of purulent endophthalmitis excluded.

Recapitulation: The incidence of purulent intraocular infection in this series of penetrating ocular injuries was 15 percent. The incidence of infection was four times greater in those eyes which had sustained damages to the lens than among those in which the lens was uninjured. The chances of the development of an infection following a penetrating injury is not definitely reduced by the oral use of "prophylactic" sulfonamides. The outlook for recovery of an infected eye is very poor, and is only occasionally improved by the oral use of sulfonamides.

(9) *Sympathetic ophthalmia.* There were 3 instances of sympathetic ophthalmia among the 172 cases herein reported. Thirteen eyes in this series were enucleated within 14 days after injury, and could hardly be expected to have developed sympathetic ophthalmia in this short interval. Therefore, the incidence of this disease among eyes retained long enough for its development is 3 out of 159, or 1.9 percent. If the 56 cases which were discarded as incomplete or inadequately followed, and in which there was no evidence of sympathetic ophthalmia when last seen, are included, the incidence of sympathetic ophthalmia is 3 in 215, or 1.4 percent. This approximate figure 1.4 percent probably represents very closely the true incidence in this series, and is similar to that reported by other authors, according to a review by Woods* in 1936. The three instances of sympathetic ophthalmia are summarized below.

The first was in a white girl, aged 7 years, who sustained a small perforating corneal wound near the limbus, with prolapse of iris, and without evidence of injury to the lens. After repair with iridectomy and a conjunctival flap, the eye recovered uneventfully and, two weeks after injury was free of signs of intraocular inflammation and apparently healed. During the fourth week, a bilateral uveitis developed, characteristic of sympathetic ophthalmia. The injured eye was promptly removed, and the sympathizing eye quieted down and returned to normal. Microscopic examination of the sympathicogenic eye confirmed the clinical diagnosis.

The second patient was a white boy, aged 14 years, who sustained a corneal laceration at the limbus, with prolapse of iris, the lens apparently remaining uninjured. Iridectomy was performed, and a conjunctival flap drawn over the wound. A good recovery appeared to be under way, but, on the third day, a severe spontaneous intraocular hemorrhage occurred. The hemorrhage proceeded to organize, a secondary glaucoma developed, and blood staining of the cornea took place. An unsuccessful attempt was made to remove the blood from the anterior chamber. After this, the eye began quietly to go

* Woods, A. C. Sympathetic ophthalmia. Part I. Amer. Jour. Ophth., 1936, v. 19, pp. 9-15.

into phthisis. Three months after injury, the uninjured eye developed a mild uveitis. The cornea of the injured eye was by this time opaque. The injured eye was removed, and the diagnosis of sympathetic ophthalmia confirmed by microscopic examination. The sympathizing eye quieted down and has remained normal. This patient was known to have a strong bleeding tendency which nearly cost him his life on two occasions, when subjected to tonsillectomy and appendectomy.

The third case was unproved. A Negro boy, aged 15 years, received a small penetrating injury of the cornea and traumatic cataract. The corneal wound healed spontaneously, without prolapse of iris. Eighteen days after injury, iridectomy and lavage of the cataract were performed. Following this operation a uveitis set in, diagnosed (on the basis of an abnormal skin reaction to beef-lens protein injected intracutaneously) as iritis phaco-anaphylatica. Under desensitization treatment with lens protein and staphylococcus toxin* the injured eye quieted down and two months after injury or five weeks after operation was free of signs of intraocular inflammation. During the third month pain set in in both eyes, and when the patient returned for examination a severe bilateral uveitis had developed, clinically characteristic of sympathetic ophthalmia. Treatment was by means of artificial fever induced by 10 intravenous injections of killed typhoid bacilli. Both eyes gradually recovered without further complication. The injured, aphakic eye finally achieved corrected visual acuity of 20/40, and the opposite eye, of 20/20.

There are several points of interest in regard to the cases of sympathetic ophthalmia in this series. In the first case, the injured eye was healing itself without the slightest clinical trace of untoward reaction; two weeks after injury it had every appearance of a perfect result. Obviously, uneventful healing does not exclude the danger of the later development of sympathetic ophthalmia. The second patient received intensive treatment with sulfadiazine for the first 6 days after injury, and then, after a lapse of 4 days, for 11 days more. Satisfactory blood levels of the drug were obtained. In one case, therefore, considerable treatment with sulfadiazine did not prevent the later development of sympathetic ophthalmia.

Recapitulation: Sympathetic ophthalmia is proved to have occurred in 2 of the 159 cases of perforating ocular injuries in which enucleation was delayed long enough for the disease to develop, and almost certainly was present in a third, an incidence of 1.9 percent. Prompt removal of the sympathicogenic eye in two cases was followed by recovery of the sympathizing eye. In the third case, in a Negro youth, both eyes recovered.

(10) *Intraocular foreign body.* No attempt is made in this report to study the diverse problems of the intraocular foreign body. The 25 instances of this complication are included here merely to serve as a basis for estimating the influence of an intraocular foreign body on the chances for recovery from a perforating ocular injury.

In this series, of the 25 eyes with intraocular foreign bodies, 5, or 20 percent, recovered visual acuity of 20/100 or better, and 11, or 44 percent, lost all vision. On the basis of this small number, it would appear that the presence of a foreign body has an unfavorable influence on the chances for recovery.

The causes of failure among these 25 eyes are as follows: In 14 instances, the intraocular foreign bodies were success-

* Burky, E. L., and Henton, H. C. Staphylococcus toxin combined with lens extract as a desensitizing agent in individuals with a cutaneous sensitivity to lens extract. Amer. Jour. Ophth., 1936, v. 19, pp. 782-785.

fully removed; 3 of these eyes recovered visual acuity of 20/100 or better. The causes of reduction of vision in the remaining 11 (or the findings after enucleation)are intraocular infection (3 cases), nonspecific uveitis (4 cases), capsular remains (2 cases), phthisis bulbi (1 case), and uncertain (1 case).

In 11 instances, the intraocular foreign bodies were not removed. Two of these eyes recovered visual acuity of 20/100 or better. In the nine cases which did not recover useful vision, nonspecific uveitis was responsible for failure in three instances, major intraocular hemorrhage in four, infection in one, and phthisis bulbi in one. In five of these eyes, the presence of the intraocular foreign body was not diagnosed clinically and was found only on histologic section. Two of the foreign bodies were cilia.

Recapitulation: Intraocular foreign bodies appear to have an unfavorable influence on the chances for recovery from perforating ocular injuries. The incidence of posttraumatic uveitis is high among these cases, but here the evidence for a cause-and-effect relationship is unsatisfactory.

The management of perforating ocular injuries

From the foregoing study, what information is there that may be useful in improving the outlook for recovery from perforating ocular injuries?

The most important decision to be made in the management of a perforating ocular injury is whether to proceed with an attempt at repair, or whether to perform enucleation immediately. This decision will be based largely upon an estimation of the statistical chances that treatment will result in recovery in the case under consideration.

If the estimation of the chances for recovery could be brought to perfect accuracy then the ideal goal of saving every possible injured eye with a maximum of efficiency would be achieved. It is fitting, therefore, to marshal the information made available in the earlier parts of this report, and to sort the various situations and complications of perforating ocular injuries into two classes: those that are reliable as prognostic signs, and those that are unreliable.

All the prognostic signs are on the negative side. No departure from the normal after traumatism is favorable. What must be determined is which abnormalities are usually reparable and which others are usually not.

The following points have been found to have a reasonably consistent adverse influence on recovery from perforating ocular injuries: (1) Injuries by blunt objects, including bullets. Injuries by very sharp instruments are much more likely to heal satisfactorily. (2) Double perforation of the globe; these may often be diagnosed by roentgenologic demonstration of the foreign body in the orbit. (3) Severe degrees of prolapse of intraocular contents; prolapse of combinations of vitreous, retina, choroid, and lens are almost always associated with irreparable disorganization. (4) Severe degrees of intraocular hemorrhage. The value of this sign is sometimes limited, since it is often impossible to distinguish between a small intraocular hemorrhage and a large one in an eye disrupted by injury. Careful transillumination may help to make the distinction. (5) Intraocular infection. Any degree of infection is seldom handled satisfactorily, even with the help of the sulfonamides, although newer chemotherapeutic agents may alter this situation. (6) The presence of an intraocular foreign body probably reduces the chances for satisfactory recovery.

The following signs, in contrast to the above, are unreliable as prognostic

guides: (1) The location of the laceration. (2) The length of the laceration; by itself this sign is of little importance, however it may imply the occurrence of two unfavorable complications—severe hemorrhage and severe prolapse. (3) Traumatic cataract in itself is not a reliable prognostic guide, although it may favor the occurrence of infection and of uveitis. (4) Small degrees of prolapse, especially prolapse of iris. (5) Minor degrees of hemorrhage.

It must be pointed out that these remarks concerning the role of the location of the injury are not meant to dispute the familiar statistical evidence that sympathic ophthalmia occurs more frequently in wounds of the ciliary body. What is meant is that when confronted by a fresh ocular injury, the surgeon's estimate of the chances for uneventful healing should be little influenced by the location of the laceration. However, later on, if healing fails to proceed satisfactorily, the presence of a wound in the ciliary body should have considerable influence in the choice of management.

A summary of the relative prognostic merits of the various complications is given in table 15. It is from such signs that the surgeon must decide whether enucleation is indicated, or whether it is worthwhile to proceed with attempts at repair.

If it is decided to proceed with attempts to repair an eye that has received a perforating injury, a choice must be made from among several possible methods of surgical attack. For the repair of corneal lacerations, there are two principal methods: The use of direct corneal sutures or of a conjunctival flap. In an effort to determine the relative merits of these and other methods of repair, the cases in this report have been analyzed in respect to the type of surgical treatment given.

The various surgical approaches in cases of corneal laceration fall into four groups: (1) No surgical interference, treatment consisting of atropine and pressure bandages; (2) simple conjunctival flap, after debridement of the wound and iridectomy; (3) corneal sutures, after debridement and iridectomy; (4) a combination of corneal sutures and conjunctival flap with debridement and iridectomy.

TABLE 15

PROGNOSTIC SIGNS IN PERFORATING OCULAR INJURIES

Factors Almost Always Associated with Failure:	Factors with no Consistent Relation to the Final Outcome:
Injury by a blunt object	Location of the perforation
Double perforation of the globe	Length of the laceration
Intraocular infection	Prolapse of iris
Severe degrees of prolapse of intraocular contents	Injury to the lens
Severe intraocular hemorrhage	Minor intraocular hemorrhage

In the study of the relative merits of each of these four methods, the discussion applies only to corneal lacerations, penetrating injuries not involving the cornea being excluded from this part of the analysis. Moreover, all cases demonstrated to be complicated by intraocular infection were likewise excluded, since this complication introduces another variable not clearly related to the type of surgical treatment. For similar reasons, cases with retained intraocular foreign bodies were excluded. After these exclusions, there remained a series of 109 eyes having corneal or corneoscleral lacerations, not infected, without retained intraocular foreign bodies, which were treated by one of the four methods given above (table 16).

Since it is important to learn if a division according to the surgical manage-

ment results in groups that are comparable, the data as to the incidence of prolapse and of damage to the lens and the average length of the laceration are given as indices of the severity of the injury. Thus in group 1, wherein treatment consisted of atropine and pressure bandage only, the injuries were shorter, there was a less frequent incidence of prolapse, although the incidence of damage to the lens was high. Moreover, most of the lacerations in group 1 were of 1, 2, or 3 mm. in length, the average being raised by three cases in which the laceration measured 9 mm. or over. In almost all of these there was spontaneous coaptation of the wound. That prolapsed iris was left in any instance is accounted for by the fact that the definition of iris prolapse used in this paper includes any case wherein iris tissue was present between the lips ot the wound, although there may have been no actual protrusion.

Thus, the first group of cases, in which no operative treatment was undertaken, is not comparable with the other groups. The results achieved in this group perhaps demonstrate that for small lacerations without prolapse nonoperative treatment is as adequate as in direct surgical repair for more serious injuries. That none of the eyes receiving nonoperative treatment required enucleation is probably a further reflection of the relatively minor nature of the injury, and there is no evident reason for attributing the superiority in this respect to the treatment.

In the remaining groups, there is a reasonable degree of uniformity in the average amount of damage sustained. One situation helps to make the remaining groups similar and comparable. In the earlier days of the Wilmer Institute, it was the practice to repair all corneal lacerations by means of a conjunctival flap, and corneal sutures were rarely used. In the last few years, this attitude has been almost directly reversed, and nearly every eye needing repair has been treated with corneal sutures, at times supplemented by a conjunctival flap. Thus there are two groups of cases in which all random influences could operate equally, and in which the decision as to the technique

TABLE 16

INFLUENCE OF THE TYPE OF SURGICAL TREATMENT ON THE FINAL VISUAL ACUITY*

Type of Repair	Average Length mm.	Iris Prolapse percent	Lens Injury percent	Final Corrected Visual Acuity			Breakdown of Wound percent
				20/100 or Better percent	Worse than 20/100 percent	Blind percent	
I No repair, 22 cases	4.0	14	59	77	23	—	—
II Corneal sutures, 21 cases	5.2	71	19	81	9.5	9.5	24
III Sutures and flap, 17 cases	7.0	88	41	65	23	12	6
Average of II and III, 38 cases	6.0	78	29	73.5	16	10.5	16
IV Flap only, 39 cases	4.8	85	38	51	28	21	13

* Corneal and corneo-scleral lacerations, excluding cases complicated by infection or by intraocular foreign bodies.

of surgical repair was influenced almost solely by the prevalent custom.

There were 39 lacerations that were repaired by a conjunctival flap, usually after iridectomy. Fifty-one percent of the eyes involved regained a corrected visual acuity of 20/100 or better, while 21 percent ended with loss of all light perception.

There were 38 cases which were repaired by the use of corneal sutures, in 17 of which a conjunctival flap was used in addition to the corneal sutures. In this group, 73.5 percent of the eyes regained a final corrected visual acuity of 20/100 or better, and 10.5 percent were blind.

The incidence of breakdown of the wound for each group is also given in table 16. Under breakdown is included delayed re-formation of the anterior chamber of over four days' duration, or loss of the anterior chamber after reformation, as well as actual gaping of the wound with or without prolapse. The incidence of breakdown is high in those cases in which corneal sutures alone were used. Here the incidence of breakdown is increased because of a few cases in which the anterior chamber was temporarily lost on removal of the sutures. Where a conjunctival flap alone was used, the incidence of breakdown was 13 percent, and where both corneal sutures and conjunctival flap were used, the incidence of breakdown was 6 percent. While the incidence of breakdown appears to be inversely proportional to the apparent watertightness of the repair, the numbers involved are small and not significant.

The apparent advantage of corneal sutures over a simple conjunctival flap must be viewed with caution. From the statistical standpoint the observed difference in the two groups is barely significant. While the groups appear to be more or less similar, there are many possible random influences which might not have occurred with uniform frequency in two groups of this limited size.

On the basis of the foregoing analysis there appears to be no distinct advantage of one method of repair over another, on the average, although one may be superior to the other in a particular case (see below).

With the foregoing evidence in hand regarding the importance of various complications and the relative merits of the various types of surgical repair, what generalizations can be made as guides in the treatment of perforating ocular injuries? The following suggestions, while not original, are familiar methods, with occasional modifications suggested by the analysis of these 172 cases.

In the first place, the usefulness of nonoperative management should be kept constantly in mind. Table 16 demonstrates that many corneal wounds which coapt spontaneously, without prolapse, are seen to heal readily under nonoperative treatment. Where such treatment can be used, it is ideal. It should not be applied when there is any material between the lips of the wound, or any gaping of the wound, since these situations tend to increase the inflammatory reaction and the amount of scarring and may delay healing. Whenever surgical debridement of the wound is necessary, closure should be effected. It goes almost without saying that before surgery is undertaken in a perforating ocular injury most careful attention should be given to the possibility of an intraocular foreign body. Even when this complication seems unlikely, it should be investigated thoroughly in the history, in the clinical examination, and (ideally) by routine roentgenologic examination.

In proceeding with the surgical treatment of corneal or corneoscleral wounds, the first consideration is debridement of

the wound. Since there is evidence that prolapse of iris may prevent the development of infection, iridectomy should always be deferred until the time of repair of the wound and other measures of protection against infection are available. Iridectomy is the wisest method for reduction of a prolapse of iris, even though it may sometimes be tempting to try to reposit a prolapsed but otherwise intact iris. The complications to be feared from the latter course are intraocular infection and recurrence of the prolapse as the aqueous is re-formed. Besides iris tissue all other material and foreign bodies should to removed from the wound and pieces of cilia should be carefully sought.

The removal of blood clots from the anterior chamber is most desirable in view of the adverse effect of a clot which organizes instead of becoming absorbed. Moreover, during surgical repair, if fresh bleeding occurs, the wound should never be closed until the bleeding stops and the hemorrhage is evacuated.

The question of the management of the complication of a traumatic cataract arises at this point. Since traumatic cataract often favors the development of more serious complications, and at best requires a second operative procedure, it is wise to remove the cataract by lavage or piece by piece at the time of repair of the injury, *provided* that the cataract is sufficiently developed so that it is susceptible of reasonably complete removal, and provided that removal can be accomplished without serious risk of aggravating hemorrhage or prolapse. Unless these provisions are met, treatment of the traumatic cataract should be deferred for several months.

For closure of a corneal or corneoscleral wound, the choice of corneal sutures versus a conjunctival flap will be based on the sum and average of the following factors: First, the degree of gaping of the wound. A conjunctival flap does not appear to be reasonable treatment if the wound is gaping under the flap. Healing will occur with a smaller scar if the wound edges are approximated with sutures. Secondly, the raggedness of the wound and the degree of maceration of tissue. If the wound edges are macerated or very much softened by early reaction, sutures are impractical, and the defect heals best with a conjunctival flap over it. Third, the degree of damage to the lens. If the lens is intact, it may be considered that the placing of corneal sutures affords an unnecessary hazard in operative traumatic cataract. Fourth, the location of the laceration. If a conjunctival flap should adhere to a central corneal wound, the resulting leukoma would be greater than if the wound were closed with sutures; the sutures need not be placed directly in the course of the visual axis, but on one or both sides of it. Fifth, the unruliness of the patient. Where poor postoperative coöperation is expected, the tighter the closure of the wound the better. On the other hand, in children, removal of corneal sutures may necessitate a second anesthesia, which is avoided by the use of a conjunctival flap with absorbable sutures, or with silk sutures which quickly cut their way out spontaneously.

When corneal sutures are used, the simplest sutures are probably the best. The cornea is usually sufficiently tough so that simple sutures give adequate closure without danger of tearing out. Simple single sutures give the least amount of scarring. They should not penetrate Descemet's membrane, but should pass in mid-stroma, to reduce the chances of temporary fistula formation on removal. Silk corneal sutures can be removed after 9 to 12 days. After closure of the wound.

the injection of air or saline in the anterior chamber is sometimes useful to prevent the formation of anterior synechiae. The use of air is preferable, since it is retained more readily. All corneal lacerations should be dressed with a firm pressure bandage.

Scleral wounds are closed if necessary with simple direct silk sutures which may be buried or may be tied outside the conjunctiva. Nonchromatized absorbable sutures are, perhaps, preferable. Such injuries are relatively rare. Theoretically they should be associated with an increased incidence of retinal separation; for this reason, the use of a few diathermy punctures about the wound may be advisable.

Nonoperative procedures are similar to those used in conjunction with other phases of ophthalmic surgery. Atropine is almost always indicated postoperatively. The "prophylactic" use of sulfathiazol or sulfadiazine in all cases is probably wise, since about one in every seven eyes with a perforating injury is lost through infection. Although statistical proof of the value of this procedure is lacking, there is reason to believe that in some cases it may be of value. The good results from artificially induced fever for the treatment of postoperative iritis is well recognized. This procedure, moreover, is occasionally used as a "prophylactic" measure before the development of the uveitis. Since the relationship between injury to the lens and posttraumatic uveitis is so striking, the prophylactic use of artificial-fever therapy should be reserved for cases complicated by traumatic cataract.

When uveitis develops in the presence of a traumatic cataract, the possibility of uveitis phaco-anaphylactica should be investigated, and can be demonstrated by an abnormal skin reaction on the intradermal injection of lens protein. If this diagnosis is established, treatment with lens protein and staphylococcus toxin may lead to recovery.

Summary

In an analysis of 172 cases of perforating ocular injuries, the following factors are seen to have a reasonably consistent unfavorable influence on the chances for recovery: (1) Injuries by blunt objects; (2) double perforation of the globe; (3) severe degrees of prolapse of intraocular contents; (4) severe intraocular hemorrhage; and (5) intraocular infection. On the other hand, recovery is not consistently inflenced by (1) the length of the laceration; (2) the location of the laceration; (3) injury to the lens; (4) prolapse of iris, and (5) minor degrees of hemorrhage. The interrelationship of some of these complications is discussed. The (corrected) incidence of sympathetic ophthalmia among these cases is 1.45 percent.

In the choice of methods of repair of corneal lacerations, the use of a conjunctival flap, or the use of direct corneal sutures appears to be about equally efficacious. Other features in the management of perforating ocular injuries are discussed.

TRACHOMA VIRUS AND THE MORPHOLOGY OF INCLUSION BODIES*

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The inclusion bodies found in trachoma may have an etiologic link with the virus that is assumed to cause the disease. Many attempts have been made to establish this view but two important difficulties stand in the way: inclusion bodies that are microscopically indistinguishable from those found in trachoma are found in other conjunctival diseases, and the virus has not been produced in culture. The bodies are found in both recent and long-standing cases of trachoma, with a frequency that increases with the care and experience of the investigator. A negative report has no value unless scrapings are examined from several areas of the fornix and both the palpebral and the bulbar conjunctiva. Much misunderstanding has arisen from the inadequate illustrations that have appeared. Even the best photomicrographs are disappointing compared with carefully executed drawings.

Towards the end of the last war I published some illustrations of the great polymorphism that may be found in these bodies (plate 2, frontispiece). Preparations made from epithelial scrapings present appearances that differ from those made from conjunctival sections. The superficial epithelial cells of the conjunctiva are probably the starting point for the infection of the deeper tissue. Consequently, great attention has been paid to them to the neglect of the deeper layers. In these superficial cells the inclusion bodies may be found sitting like a cap on the nucleus, although some may lie free in the plasma. They may differ in size and intensity of staining. In size their elements may vary from 0.25μ to nearly 1.0μ in diameter, and a clear halo may surround them. In plate 1 the blue-stained bodies can be seen to vary in shape very considerably; "cocci," barrels, double "cocci," rings, dumb-bells and hour-glasses may be present. The whole cell may be full of these bodies and the wall may burst, thus liberating them. Such open cells may be seen in both scrapings and in sections. They are probably not due to artifact but actually occur in life. It may be that these small elementary bodies are the actual virus elements which are distinguishable from the larger initial bodies.*

In two cases of traumatic conjunctivitis I suspected infection with trachoma. Epithelial smears were taken daily from the third day after the accidents. The findings were negative until the sixth day when intracellular elementary bodies and all shapes of initial bodies were found in many epithelial cells. These elements were present in increasing number on the ninth day and the first typical inclusion bodies were found on the fifteenth. They were few in number and stained lightly. Both these patients later developed classical trachoma, with many typical inclusion bodies. The disease finally subsided after some months of energetic mechanical treatment. The impression gained is that the elementary bodies intrude upon the cell from without, develop into the initial body, and by the multiplication of the latter the characteristic inclusion

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* The cells shown in the illustrations were drawn for me by Mr. Zovetti.

bodies are formed. If this speculation is correct it follows that both initial and elementary bodies may be found in the cells without any inclusion bodies. The aforementioned cases would give support to this view.

Trachoma is not a disease restricted to the epithelium. The principal pathologic reaction is seen in the submucosa, where large masses of lymphocytes, plasma cells, and fibroblasts infiltrate the tissues. Deep scarring may shorten the conjunctival fornix, and the infiltrated tarsal plate may be distorted. These well-known clinical facts suggest that the infective process penetrates deeply into the tissues. In a report to the International Ophthalmological Congress in Egypt, Wilson (1937) stated that "true inclusion bodies, which one finds in the epithelial cells of the conjunctiva, are not found within the trachomatous follicle." On the other hand, subepithelial caps of extremely small Giemsa-staining elementary bodies (rickettsia) were reported by Cuénod and Nataf (1935, 1936, and 1937). They have been found in smears from the contents of trachoma follicles. Cuénod stated that they were "not common mast-cells, but cells filled with parasites."

I prepared paraffin sections from the conjunctiva of the fornix derived from 23 cases of trachoma. Moreover, I was able to study four excised trachomatous tarsal plates histologically. For two of them I am indebted to MacCallan. I acknowledge gratefully his kindness. The sections were stained with hematoxylin and eosin, van Gieson, Unna-Pappenheim, and Giemsa stains. In a certain number of sections both Victoria blue and polychrome methylene-blue stains were used. In areas where typical inclusion bodies were found in the superficial layers the underlying tissue was carefully examined. The inclusion bodies were situated in nests (figs. 4a, 4b) in the superficial epithelial layers, mostly in groups of 30 to 50, surrounded by epithelium free from inclusion bodies. They differed from those found in the smear preparations in that most of them lie within delicate cystlike compartments. The "initial bodies" did not vary in shape to the same extent as in the smear preparations. The elementary and initial bodies could be distinguished only by the size of the granules. The smaller compartments contained 2 to 5 units whilst the largest might contain 30 to 40. The number appeared to be conditioned by the size of the balloonlike spaces. This cystlike appearance can be seen most easily with Giemsa staining, being but rarely visible when hematoxylin and eosin were used.

No such cystlike compartments were found in the deeper epithelial layers. But inclusion bodies may be present as deep as the basal epithelial cells. These corpuscles are freely imbedded in the epithelial layer, and the halo seen in the superficial layers or that of the smear preparations is absent. This halo is assumed to be a jellylike mucous substance (van Rooyen and Rhodes, 1940). The nucleus of the invaded cell may be displaced by the bodies; sometimes the whole plasma may be occupied by inclusions and no nucleus can be seen. Polymorphonuclear leucocytes migrating through the epithelium did not contain any inclusion bodies or Giemsa-staining granules (figs. 4c-8d).

In all advanced cases the submucosa contains numerous follicles, many of them forming densely infiltrated areas. These follicles consist of lymphocytes, plasma cells, leucocytes, and fibroblasts. Basophilic mast cells were found frequently in the less densely infiltrated reticulum (plate 5). Some of these cells displayed a typical wheel-shaped nucleus, others were reticulum cells with large,

pale nuclei and very little chromatin. The cells of fibroblast (histiocytes) type were frequently packed with blue and purple granules. Sometimes granules of both colors were found in the same cell. These granules may also lie in heaps free in the tissue and small groups may be seen without any relation to cells. Serial sections stained alternatively with Giemsa and hematoxylin were examined, and no basophil granules were found in the latter. Under high magnification (×1,350) reticulum cells full of delicate elements showing both metachromatic and blue staining were seen frequently in the same field. Others showed a cytoplasm full of corpuscles with considerable variation in size (fig. 8c).

Sections prepared from the tarsal plate that had been excised from long-standing cases of trachoma were examined by the aforedescribed methods. The whole tarsal plate was filled more or less with reticulum cells choked with dark blue or purple elements stained with Giemsa; thin fibroblasts were seen to be filled with blue or purplish granules; and many round elements were seen free in the tissues. Sometimes chains were formed like small streptococci. Similar appearances were present in the submucosa of the bulbar conjunctiva (figs. 9-10).

Slides were prepared from two cases of follicular catarrh, and from acute and chronic conjunctivitis. No epithelial inclusions were found from scrapings in any of these, but basophilic mast cells were frequent in the sections of follicular catarrh. The granules of these cells could not be distinguished from those occurring in the trachoma cases.

Discussion

The morphologic appearance of the various types of epithelial inclusions strongly suggest that they are the virus elements. The differences between the appearances in scrapings and in sections may be due to the technique employed. I cannot explain the reason of this difference nor why the colonies in the deeper epithelial cell rows do not show the cyst-like appearance found in the superficial layers. The nestlike localization of the inclusion bodies indicates the need for most exhaustive examination of the sections. It often happened that a negative section was found to be positive after repeated scrutiny. The difficulties increase when a search is made for intraplasmatic single elements in the deeper tissues which may be quite obvious in epithelial scrapings. Only the colonies can be recognized in sections without difficulties.

I imagine that the series of events is

Plate 5 (Loewenstein).

Fig. 4b. Fornix region. Old case of trachoma. Superficial epithelial row with encapsulated virus colonies. The deeper cell rows contain colonies without haloes. Giemsa staining, ×675.

Fig. 4c. The same section, basal epithelial row with subepithelial tissue. One inclusion body in the epithelial cell row; two reticulum cells filled with Giemsa-blue granula.

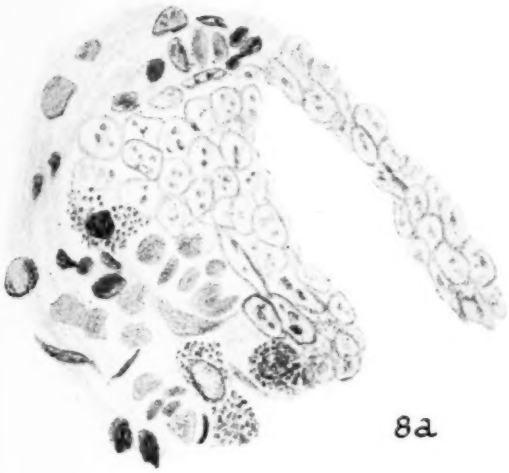
Fig. 5a. Case of old trachoma. Intraepithelial "mast cell" surrounded by virus-infected epithelial cells. Giemsa staining, ×1350.

Fig. 6. Case of trachoma from the fornix region. Inclusion bodies in superficial epithelial cells only; polymorphonuclear leucocytes entirely free from virus elements. Giemsa staining, ×1350.

Fig. 8a. Case of trachoma. Purplish granula in reticulum cells. Giemsa staining, ×675.

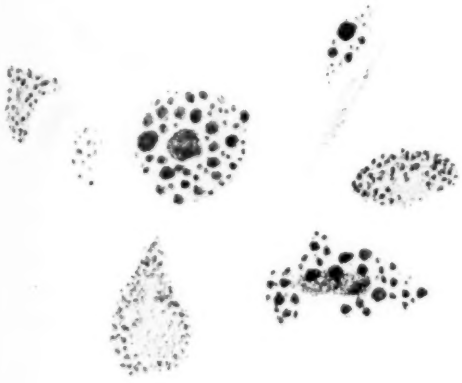
Fig. 8b. Case of old trachoma. Basic layer of epithelium (a). Reticulum cells in submucosa filled with granula partially blue, partially purple. Giemsa staining, ×1350.

Fig. 8c. Case of trachoma, fornix region, from different fields. Mast-cell granula very large, metachromatic. Other cells contain metachromatic corpuscles also, but much smaller. Variant size of metachroic granula. Giemsa staining, ×1350.



8a

5a



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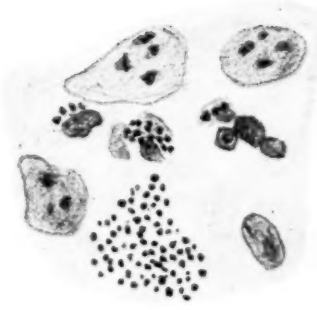
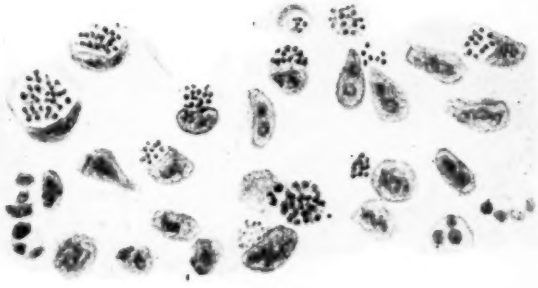


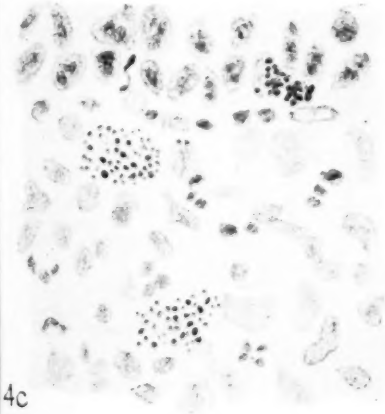
a

b

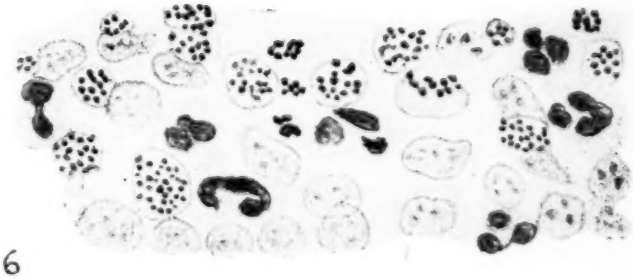
8b



4b



4c



6

10

9b

5b

8d

9a

9c

somewhat as follows: The virus invades the superficial epithelial cells of the conjunctiva where its elements grow into colonies, the inclusion bodies. The virus elements are carried into the deeper epithelial layers by the lymph stream and reach the subepithelial tissue. At that level a follicular growth is produced, analogous to that found in lymphatic leukemic tumors. The interaction between virus and tissue conditions the production of follicles and the predominantly lymphocytic growth. The fibroblasts, which are present from the earliest stage (Birch-Hirschfeld, 1938), may act as phagocytes by reabsorbing the virus, although unable to destroy it. The subsequent development of fibrous tissue thus leads to the deep storage of infective material. This may account for the frequent relapses in cases of long-standing trachoma. It is another reason justifying the excision of the tarsal plate in such cases.

Fig. 4a

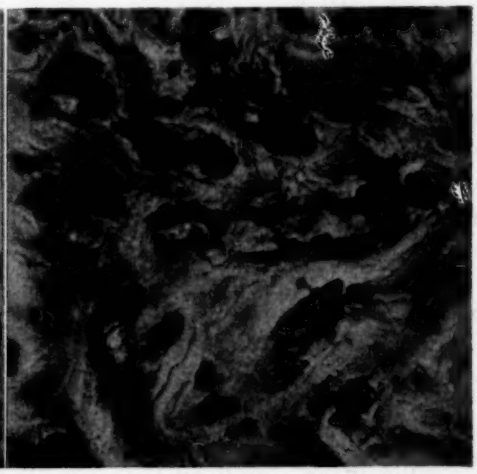


Fig. 7

Fig. 4a (Loewenstein). Inclusion bodies in superficial epithelial row from a case of trachoma. Giemsa staining, ×675.

Fig. 7 (Loewenstein). Case of trachoma, section of the submucosa. Reticulum cells full of basophil granula. Giemsa staining, ×1350.

Reticulum cells with round granules staining with Giemsa were observed in two cases of follicular catarrh. Certain

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Plate 6 (Loewenstein).

Fig. 5b. Case of trachoma. Intraepithelial virus; elements without halo. Giemsa staining, ×1350.

Fig. 8d. Case of trachoma. Reticulum beneath follicular infiltration; six "mast cells" in one field. Giemsa staining, ×675.

Fig. 9a. Case of trachoma, tarsal section. Center of the excised tissue reticulum. Cells filled with initial bodies and elementary corpuscles (granula?). Giemsa staining, ×675.

Fig. 9b. Tarsus. Reticulum cells full of initial bodies (basophil granula?). Giemsa staining, ×675.

Fig. 9c. From center of tarsus. Basophil granula; initial bodies (?) in reticulum cells surrounding a vessel. Giemsa staining, ×1350.

Fig. 10. Case of old trachoma. Contents of follicle. Four "Leber" cells from different fields surrounded mostly by plasma cells. The two cells on the extreme left (upper and lower) are hematoxylin and eosin stained. Giemsa staining, ×675.

forms of this condition are infectious and may be due to a virus, although visible epithelial inclusion bodies have not been seen so far. I have seen similar reticulum cells filled with Giemsa blue granules in pemphigus of the conjunctiva, although no inclusion bodies were found in conjunctival scrapings. The virus nature of this conjunctival disease was discussed by Gallardo and Hardy (1943). Molluscum contagiosum is considered to be a virus disease also (Lipschütz, 1913), and follicles of a similar type to those of trachoma are found in this disease.

The whole problem of the nature of inclusion bodies in these conditions calls for much further investigation. The present observations remain inconclusive. There is not more than a probability that both the intraplasmatic Giemsa-staining elements in the reticulum cells and the extracellular ones are the virus itself.

Summary

In advanced trachoma the follicles consist of lymphocytes, plasma cells, fibroblasts, and macrophages [cytophages (Marchand)]. The last may be very large and contain half digested cells, remains of erythrocytes, splinters of nuclei, but no granules suggesting inclusion bodies. The cell remnants stain with both Giemsa and hematoxylin. The caps reported by Cuénod in the cells of the follicles were not found in any of the 23 cases of advanced trachoma which form the basis of this histologic investigation. Metachromatic granules, rather indistinct and cloudy, were found in plasma cells having a typical wheel-shaped nucleus.

The appearance of the inclusion bodies differs in scrapings and in sections. In the scrapings they show considerable polymorphy, and individual elementary and initial bodies may be found alone in the cells.

In sections, encapsulated inclusion bodies with many Giemsa-staining elements are found in the superficial epithelial layers. In the middle layers the encapsulated inclusions tended to be smaller, with fewer elements. Groups of elements lying free in the epithelial plasma without either capsule or halo may be the virus itself as well. No encapsulated colonies were seen in the deepest layers of the epithelium. In the middle and deepest epithelial layers single reticulum cells full of metachromatic granules were present.

In the subepithelial tissues, reticulum cells of fibroblast character were filled with blue and purple granules. The size varied, but many were equally sized and equal to that of the intraepithelial elements. Granules were free in the tissues, some single and others in colonies.

The diseased tarsus was found to be full of reticulum cells of fibroblast character with blue and purplish elements in large numbers, both inside and outside the cells. Similar granules were not found either in the lymphocytes or in the plasma cells.

It is possible that both the intraplasmatic Giemsa-staining elements in the reticulum cells and the extracellular elements are the virus itself.

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IODIDE THERAPY FOR SENILE MACULAR DEGENERATION*

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In 1885 Haab[1] described the condition which we know as senile macular degeneration. De Schweinitz[2] pronounced this a loose term and classified it as a lesion or lesions which arise in senescence, at 50 years of age and older. His description of senile macular degeneration is a masterpiece:

> In the very early stage the macular area may exhibit features which differ only slightly from those common to elderly people; a color darker than normal, a faintly muddy hue or a delicate mottling. Later, close focusing reveals a number of brownish black granules interspersed with others which are light colored. Occasionally there are white glistening dots which are often mistaken for Gunn's dots, with which they have nothing in common. In the macula are small yellowish white spots, interspersed with pigment dots and minute hemorrhages, or irregular shallow erosions, which may go on to atrophy of the elements and slight pigment heaping. The descriptive title, moth eaten macula has been applied. While it is true that in these early stages the visual disturbance is often out of all proportion to the inconspicuous pathological changes, it is also true that sometimes at this period, although sight is indistinct the vision is normal for the usual tests. It is generally maintained that treatment is unavailing. The prognosis of this condition is favorable in that it does not produce total blindness, but it is not influenced by any form of treatment.

Duke-Elder[3] agrees that treatment is extremely unsatisfactory. He believes the condition to be due essentially to processes outside medical control. Moreover, in all such cases we are dealing with tissues of low vitality which are in no condition to respond to therapeutic or stimulatory measures.

This prognosis leaves a patient with but little hope. It offers a sad outlook for the remainder of his allotted days, at the time when he is frequently limited in physical ability and needs his vision desperately to live with any degree of happiness. It is the purpose of this paper to hold out some hope to this type of patient.

Volumes have been written on sclerosis of the retina, while relatively little has appeared in print concerning sclerosis of the choroid. This discrepancy is due to the fact that the retina may usually be examined with the ophthalmoscope but the choroid only occasionally. H. Friedenwald,[4] J. S. Friedenwald,[5] de Schweinitz,[2] and H. Wagener[6] (among American authors) have contributed much to our knowledge of retinal sclerosis. It is believed that retinal sclerosis plays a negligible part in senile macular degeneration.

Duke-Elder,[3] in defining senile macular degeneration, writes that it is due to sclerosis and obliteration of the choriocapillaris. B. Rones[7] also is of this opinion. He states: "Obliteration of the choriocapillaris is of primary importance in producing the retinal changes. The pigment epithelium is an early sufferer from

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* Candidate's thesis accepted for membership in the American Ophthalmological Society, June, 1944.

this diminished circulation and its changes are partly of a proliferative and partly of a degenerative nature." Kondo[8] considered sclerosis of the choroidal vessels to be of cardinal importance in macular degeneration. The majority of writers agree with this explanation as the cause of senile macular degeneration.

J. S. Friedenwald[5] states that "Atheroma of the choroidal vessels does not manifest itself directly in any ophthalmoscopically visible change. This statement can be made with some assurance because the great majority of persons over 65 years of age have histologically demonstrable atheromatous changes in the choroidal vessels while only a small proportion exhibit these atrophic changes in the choroidal tissues which are attributed by clinicians to choroidal sclerosis. These atrophic lesions occur preëminently in the macular and peripapillary regions and in the extreme periphery of the fundus." Cohen[9] states, "Arteriosclerosis may exist in any of the intraocular vessels without clinical evidence of its presence elsewhere in the body." Friedenwald further states: "Until more definite evidence is available to show these atrophic lesions are directly connected with disease of the blood vessels, it seems best to classify them along with peripheral cystic degeneration of the retina and the pigment atrophy of the pupillary margin of the iris as senile rather than arteriosclerotic." That many authors are in agreement with this opinion is unquestioned.

A. Sorsby[10] and P. Waardenburg[11] have presented proof that some cases may be abiotrophic.

The pathologic changes have been investigated by Nagel,[12] Harms,[13] C. Behr,[14] J. S. Friedenwald,[5] and Rones.[7] Nagel was chiefly concerned with the yellowish white spots found about the posterior pole of the globe. He concluded that these spots were granules of calcium carbonate in drusenlike thickenings located in the lamina elastica. Pigment granules were not found in such thickenings but always upon the surface of the smaller and entirely displaced only by the larger thickenings. He thought the impairment of vision was due to pressure of these thickenings upon the external layers of the retina. He does not mention the condition of the blood vessels.

Harms found the lesions confined to the pigment epithelium and neuroepithelial layer of the retina, with the choroid not involved. C. Behr confirmed the findings of Harms. He advanced the suggestion that senile macular disease should be regarded as a special type of hereditary degeneration, depending upon a congenital predisposition to premature death of the macular retinal neurons.

Friedenwald reports "In these cases the essential lesion seems to be in the choroid, and while it may occur at any point in the fundus, the point of election is at the macula. The choroidal capillaries here become obliterated and show hyalin degeneration. There is both atrophy and proliferation of the overlying retinal pigment epithelium, with the formation of many colloid excrescences on Bruch's membrane and some scattering and heaping up of pigment. The deeper layers of the retina which are dependent upon the choroidal capillaries for their nutrition become atrophied and disorganized; indeed, the atrophy may extend throughout the whole macular region."

Rones states:

> Histologically it is evident in these cases that obliteration of the choriocapillaris is of primary importance in producing the retinal changes. The role played by the choriocapillaris in the nutrition of the retina is of the utmost importance, and consequently, any great impairment of its function must necessarily exercise a deleterious influence upon its dependent tissues. The pigment epithelium is an early sufferer from this diminished circulation, and its changes are partly of a proliferative and partly

of a degenerative nature. Many of the cells increase considerably in size, so that the layer loses its regular appearance. Though there is evidence of cellular division, many cells show signs of degeneration, with pale vacuolated nuclei. There is also considerable variation in the pigment content of the cells and many of them lose all of their pigment. The pigment granules do not have their normal rod form, but become small and round, and with the destruction of the cells are scattered over the basal membrane. In elderly people the choriocapillaris exhibits many caliber variations, some vessels being almost occluded while others exhibit compensatory dilatation. The arteries are also seen to vary in their caliber and their walls show definite thickening. Where an artery is found to be occluded, the entire zone of choriocapillaris which it feeds is found to be atrophied, while an adjacent zone may appear quite normal. It follows that atrophy of the capillary layer occurs in a very patchy manner.

In the earlier stages of senile macular degeneration the patient complains of a slight blurring of vision which persists after refraction. If the macula is carefully examined usually a slight disturbance of pigment or a paleness will be detected which may vary only slightly from the normal. Sclerosis of the retinal vessels may or may not be present at this time. In the cases reported here sclerosis was present in every instance. Later in the progress of the disease there is a minute dispersal or heaping of pigment which manifests itself as small light or small dark dots. Retinal sclerosis is nearly always present at this stage. Still later these pigment changes are conspicuous and in the end stages the macula is almost entirely destroyed, only a few small clumps of retinal cells remaining in this area. In any stage of these changes a macular hemorrhage may complicate the ophthalmoscopic picture and hasten the progress of destruction.

The vision may be impaired early in the disease when the fundus examination reveals a questionable variation from the normal fovea and when sclerosis of the retinal vessels is not marked. In certain cases the vision may not be impaired until the macular changes are easily discernible. The impairment of vision may be out of all proportion to the ophthalmoscopic picture and again the vision may be surprisingly good where the damage to the fovea is extensive. In the latter instance the vision is nearly always diminished. In the later stages the vision is invariably poor.

The foveal changes can usually be seen in senile macular degeneration, so perimetry is not often employed. Traquair[15] states that even when minute retinal lesions are detected, the field defects often indicate a much larger area of functionally altered retina than is indicated by the ophthalmoscopic findings. In some instances, relative blue-yellow blindness may be present. At times the scotoma may be central and less than two degrees in diameter, whereas in other cases the field defects suggest homonymous or bitemporal hemianopic or quadrant-shaped scotomata. This may be the case without the presence of visible corresponding retinal lesions, for it is by no means always possible to correlate the field defects with the visible foveal changes. This discrepancy of findings is due to the patchy atrophy of the choriocapillaris described by Rones.

Senile macular degeneration is encountered in persons of middle age or beyond, who usually are in reasonably good health and actively engaged in some occupation. It is less often encountered in individuals with poor health. They frequently have a slight increase in systolic blood pressure and in many instances hypertension of a mild or severe degree may be present. These patients are frequently of a nervous temperament and some are apprehensive concerning the prognosis of their vision.

Iodine was first discovered by Bernard Courtois, a Parisian chemist, in 1811.

Since that time it has had a varied and interesting history. It has been prescribed for most of the ills of humanity at one time or another. Volumes have been written upon its various actions but despite this its hormone and alterative mysteries are not completely solved. There is considerable diversity of opinion among clinicians and experimental investigators with respect to its influence upon the circulation and the vascular system.

In 1914 Schwalbe[16] sent questionnaires to practitioners and clinicians. Their answers revealed an evident lack of agreement as to the action of iodide in arteriosclerosis, as well as to the favorable alterations and functional amelioration it induces, and finally its value as a symptomatic agent against subjective manifestations. In a review published in 1933, Liebig[17] was unable to report any recent observations from this angle.

Experimental investigations of the effect of iodine on the circulation have embraced mainly: (1) Its effect upon vascular caliber; (2) effect upon pathologic alterations of the vascular walls; (3) effect upon blood mass; and (4) effect upon viscosity of blood plasma.

In 1927, Guggenheimer and Fisher,[18] in experiments with animals, found that iodine produced vasodilation and fall in blood pressure, the best results being obtained with a dilution of 1:1-5 million. Freund and König[19] in 1928; Mancke in 1930;[20] Osterman[21] in 1930; and Barkan and Prikk[22] in the same year could not obtain these results with similar experimentation. Barkan and Prikk stated: "With regard to the circulation, the action of iodide has not as yet been clarified by experiment. In this and other respects it still remains a pharmacological problem."

Murata and Kataoka in 1917;[23] Liebig in 1931; Turner in 1933;[24] and Page and Bernhard[25] in 1935, found that iodine in large doses prevented the occurrence of atheromatous vascular changes in rabbits fed with cholesterol. Attention was directed to the importance of the thyroid gland by Shapiro in 1927.[26] Turner and Khayat[27] in 1933, found that the presence of the thyroid gland is a prerequisite for the manifestation of this action of iodine. Murata and Kataoka determined that the presence of thyroxin was a factor in retarding these changes. This was corroborated by Turner in 1933, and by Friedland[28] in the same year.

Handousky[29] (1938) experimented by feeding dogs large amounts of pure vitamin D. No changes could be found in the arteries of the normal animal. Following removal of the thyroid and parathyroid severe sclerotic changes in the aorta as well as the pathologic picture of a nephrosclerosis ensued. If thyroxin was administered to the animals after the operation, simultaneously with the vitamin these aortal changes did not appear. Handousky concluded that a hyperfunction of the thyroid favors the occurrence of arteriolonecrosis and inhibits arteriosclerosis; a hypofunction inhibits arteriolosclerosis and favors the appearance of arteriosclerosis.

Kraus[30] (1935) found that 4-percent abrodil produced a maximal dilatation of intact vessels in the ear of a rabbit, although he tested concentrations as high as 40 percent. An interesting item is reported by Saglitzer, Demel, and colleagues[31] (1930-34). They injected urocelectan or abrodil for the purpose of arteriography in patients with severe arteriosclerotic disturbances of the extremities. Some of these patients were so improved by a single injection that they were able to resume their former occupations for periods up to three years. Nils Alwall[32] (1939) gives a very excellent

bibliography in a résumé of the iodide problem and adds the results of his experiments on plasma viscosity. He concludes that iodides have little or no effect on the plasma viscosity and suggests that iodides may exert their influence upon the pathologic changes of the vascular wall.

Many ophthalmologists are prescribing iodides in various forms but only a few have recorded their results in the literature. Pflüger[33] used iodine trichloride solution 1:3,000 to 1:2,000 for cases of acute infection and sodium iodide with sodium chloride for chronic cases. His method was to inject 2 to 4 gm. subconjunctivally, combined with paracentesis of the anterior chamber. He obtained spectacular results in various intraocular infections, progressive myopia, detachment of the retina, and central retinochoroiditis. Gallemaerts[34] injected postassium-iodide solutions subconjunctivally. Sourdille[35] and Panas[36] treated several types of choroiditis with pure iodine and solutions of potassium iodide; one injection every two to three days in conjunction with constant current, and reported excellent results in various conditions, and improvement in choroiditis macularis. Naegeli[37] studied the effect of subconjunctival employment of iodipin, recommended as a substitute for the iodides, on the eye of the rabbit. He found it well tolerated, although subcutaneous injections of slightly larger doses deposited approximately the same amounts of iodine in the various tissues of the eye. He considered the iodine to act as a very energetic agent of resorption, especially of pathologic substances.

Schiele[38] presents a comprehensive review of the history of the injections of sodium-iodide solutions. His preferred method was to inject 1 c.c. of 1:1,000 solution of sodium iodide to which three drops of 1-percent acoin (a local anesthetic) had been added.

Jensen[39] and Cowan and Jordan[40] inject Pregl's solution subconjunctivally for various ocular affections with good results.

E. Metzger[41] preferred 10 c.c. of 10-percent solution of sodium iodide given intravenously, and found that this was tolerated by patients who were sensitive to other preparations of iodide. He recommended daily injections in severe cases.

In the series of cases, reported by the present writer, oral administration was composed of protiodide of mercury in 0.125- to 0.25-gr. tablets thrice daily. If it was thought that this form of iodide would not be tolerated, either Lugol's solution or saturated potassium iodide was given. The dosage of the iodide solutions was gauged by the individual tolerances, and in no instance was a dosage of 20 drops thrice daily exceeded. The usual variations of tolerances were encountered. Some patients were able to take fairly large doses while others could not endure iodide in any form without severe gastric discomfort or the appearance of skin rash. Little difference was noted in the end results brought about by these three types of iodides. More than one half of the cases reported in this series improved on oral administration alone. This percentage would undoubtedly have been larger had all the cases been tried on this method but, for various reasons, some were given iodides by injection from the beginning of their treatment. Administration was continued as long as the vision improved and then was given on alternate months. It was discovered that in certain cases the vision, in a few months, would decrease if iodides were entirely discontinued.

Four different preparations of iodide for subcutaneous injection were admin-

TABLE 1

RESULTS OF IODINE MEDICATION FOR SENILE MACULAR DEGENERATION

Case No.	Age	Months Observed	Original Vision	Best Vision	Vision Last Seen	Medication	Complications
1	55	48	0.5	0.7	0.6	P	
2	55	48	0.4	0.7	0.6	P	
3	70	12	0.9	1.1	1.1	P	
4	68	13	0.2	0.8	0.8	P	
5	68	13	0.1	0.4	0.4	P	
6	66	24	0.07	0.2	0.1	I	
7	66	24	0.09	0.3	0.1	I	
8	67	21	0.3	0.5	0.4	L	
9	67	21	0.3	0.5	0.4	L	
10	65	21	0.04	0.9	0.9	P	PNH
11	81	24	0.1	0.2	0.2	K, P	
12	81	24	0.1	0.2	0.2	K, P	
13	66	36	0.5	0.7	0.5	P	
14	62	12	0.5	0.7	0.7	I	
15	62	12	0.1	0.6	0.6	I	FP
16	54	36	0.5	1.0	1.0	P	FP
17	54	36	0.4	0.9	0.8	P	PNH
18	65	23	0.6	0.8	0.5	P & I	PNH
19	65	23	0.4	0.4	0.2	P & I	
20	64	13	0.1	0.6	0.6	P	
21	56	3	0.8	0.9	0.9	P	
22	56	3	0.8	0.8	0.8	P	
23	64	61	0.5	0.8	0.8	P	
24	64	61	0.1	0.6	0.6	P	
25	61	37	0.7	0.9	0.9	K & P	
26	61	37	0.7	1.0	1.0	K & P	
27	61	26	0.9	1.2	1.1	P	
28	70	3	0.1	0.6	0.6	P	
29	70	3	0.1	0.6	0.6	P	
30	67	28	0.5	0.8	0.8	P	
31	67	28	0.9	1.0	1.0	P	
32	66	35	0.6	1.0	1.0	P	
33	66	35	0.2	0.2	light	P	CM
34	64	23	0.8	1.0	0.5	P	
35	64	27	0.2	1.1	1.1	P	
36	64	27	0.4	1.1	1.1	P	
37	62	7	0.3	1.1	0.6	P & I	CI
38	62	7	0.5	0.8	0.6	P & I	CI
39	70	3	0.8	1.2	1.2	I	
40	70	3	0.9	1.0	1.0	I	
41	75	2	0.4	0.7	0.7	L & I	
42	75	2	0.1	0.1	0.1	L & I	
43	67	9	0.4	0.6	0.5	P	
44	67	9	0.5	1.0	0.9	P	
45	62	3	0.9	1.2	1.2	P	
46	62	3	0.8	1.2	1.2	P	
47	68	2	0.5	0.6	0.6	I	
48	68	2	0.06	0.3	0.2	I	
49	54	25	0.4	0.6	0.6	L	
50	54	25	0.7	0.9	0.9	L	
51	61	1	0.5	0.8	0.8	P	
52	61	1	0.3	0.5	0.5	P	
53	70	1	0.5	0.5	0.5	P & I	
54	70	1	0.6	0.6	0.6	P & I	
55	62	9	0.4	0.4	0.2	P	
56	64	2	0.6	1.0	1.0	P	
57	64	2	0.6	1.0	1.0	P	FP
58	78	4	0.6	0.8	0.8	P	
59	62	1	0.9	1.2	1.2	P	
60	62	1	0.9	1.2	1.2	P	
61	66	1	0.5	0.8	0.8	I	
62	70	6	0.2	0.2	0.02	I	
63	70	6	0.2	0.2	0.1	I	

TABLE 1—*Continued*

Case No.	Age	Months Observed	Original Vision	Best Vision	Vision Last Seen	Medication	Complications
64	72	7	0.4	0.7	0.6	I	PNH
65	72	7	0.5	0.8	0.6	I	PNH
66	75	37	0.2	1.0	0.7	P & I	CI
67	75	37	0.2	1.1	0.8	P & I	CI
68	61	8	0.1	0.5	0.5	P	
69	66	6	0.5	0.7	0.7	P	
70	61	9	0.4	0.7	0.7	I	FP
71	61	9	0.1	0.2	0.2	I	
72	71	2	0.9	1.1	1.1	P	
73	71	2	0.6	0.8	0.8	P	
74	56	11	0.09	0.1	0.1	P & I	
75	56	11	0.03	0.1	0.1	P & I	
76	75	23	0.2	0.3	0.3	I	PNH
77	75	23	0.6	0.6	0.6	I	PNH
78	70	24	0.8	1.1	1.1	I	
79	52	30	0.3	1.0	1.0	P	
80	52	30	0.3	1.0	1.0	P	
81	80	1	0.4	0.6	0.6	P	FP
82	80	1	0.4	0.6	0.6	P	FP
83	71	16	0.1	0.3	0.3	P	
84	71	16	0.2	0.4	0.4	P	
85	80	4	0.1	1.1	1.1	I	
86	79	4	0.3	0.5	0.5	I	
87	79	4	0.1	0.3	0.3	I	
88	71	7	0.5	0.9	0.8	I	
89	71	7	0.6	1.0	0.9	I	
90	72	48	0.2	0.5	0.5	P & I	FP
91	72	48	0.2	0.5	0.5	P & I	FP
92	87	23	0.2	0.5	0.4	P	
93	71	25	0.6	0.6	0.4	K, P & I	
94	71	25	0.7	0.8	0.7	K, P & I	
95	73	5	0.3	0.5	0.5	L	
96	73	5	0.2	0.6	0.6	L	
97	74	1	0.5	1.0	1.0	I	
98	55	2	0.9	1.2	1.2	L	
99	78	16	0.7	0.9	0.9	I	
100	78	16	0.6	0.9	0.9	I	
101	70	48	0.4	0.9	0.9	P	
102	70	48	0.5	0.9	0.9	P	
103	73	1	0.4	1.2	1.2	I	
104	73	1	0.5	0.9	0.9	I	
105	71	1	0.3	0.3	0.2	L	
106	71	1	0.5	0.8	0.8	L	
107	75	62	0.7	1.1	1.1	L	
108	75	62	0.8	1.1	1.1	L	
109	82	2	0.7	0.9	0.9	P	
110	82	2	0.1	0.2	0.2	P	
111	68	4	0.4	1.1	1.1	P	
112	70	6	0.6	0.9	0.9	P	
113	67	2	0.8	1.0	1.0	I	
114	67	2	0.8	1.0	1.0	I	
115	69	24	0.7	1.1	1.1	P & I	

Abbreviations: P—protiodide of mercury $\frac{1}{8}$- to $\frac{1}{4}$-gr. doses; L—Lugol's solution; K—Potassium iodide; I—Subcutaneous injection of iodide; PNH—Pale nerve head; CI—Increase of lens opacities; CM—Cataract matured; FP—Fundus changes which could complicate the results obtained as listed in syllabus.

istered, each of which seemed equally effective. For this method 1 c.c. was injected subcutaneously twice or thrice weekly, so long as the vision continued to improve. When this point was reached the injections were discontinued and oral administration as described above was given on alternate months. In a few cases it was necessary to give the injections on alternate months to maintain the im-

proved vision, for the vision would decrease when these patients were on oral administration.

Ten eyes improved when iodides were given by injection which had failed to show any improvement on oral administration.

In this series of 67 patients with a total of 115 eyes, which showed senile macular degeneration, the eldest was 87 years of age and the youngest was 52; the average age being 70.34 years. The longest any patient was under observation was five years, and the shortest period of observation was one month; the average time of observation was 15.13 months. The poorest original vision in this series was 0.03 and the vision of this eye increased to 0.1 under administration of 0.25 gr. of protiodide of mercury thrice daily. This vision was maintained for 11 months, when the patient was last seen. The most acute original vision included in this series was 0.9, and in these eyes foveal changes were present. Ten eyes were not improved by any method tried. Fifty-six eyes improved with oral administration. Ten eyes showed no change while under oral administration but did improve when iodides were injected subcutaneously. The average improvement of the 115 under treatment was 89 percent. The most marked improvement was from 0.04 to 0.9, which is 22.5 times the original vision. Subcutaneous injections were given in this case. In only 15 eyes were the lenses clear. In five eyes lens opacities increased appreciably while the patient was undergoing treatment, one cataract becoming mature. One eye had occlusion of two small branches of the inferior nasal artery and in another eye a small retinal hemorrhage was found adjacent to the macula. Seven discs showed a decreased capillarity. Two eyes had choroidal sclerosis and two showed scattered areas of choroidal degeneration. All eyes had sclerosis of the retinal vessels to some degree and all had mild refractive errors with the exception of three aphakic eyes which required a high correction for compound hyperopic astigmatism. The vision in each instance was taken with the error of refraction corrected at that time.

It is interesting to note that 29 eyes showed a decrease in vision after the initial improvement. One of the 29 was under observation only two months (no. 48). Two eyes (no. 107 and 108) which were under observation 62 months did not show any decrease in vision.

An undetermined number of patients who were unable to read with the original vision but who could read with their improved vision, complained because they were able to read for short periods only.

Two cases are worthy of especial mention. The first was of a woman, aged 67 years, with incipient lens changes, moderate arterio- and arteriolar retinal sclerosis and stippled maculas, whose vision was 0.4 and 0.45. She was given protiodide of mercury, gr. 0.25 thrice daily, and three months later had attained a vision of 1.0 in each eye. At this time the medication was discontinued. Eight months later she reported with a vision of 0.2 in each eye and again protiodide of mercury, gr. 0.25 thrice daily, was prescribed. In three months her vision had increased to 1.1 and 1.2. She continued with this treatment and retained normal vision for two years, when the lens opacities increased, so that by the end of a third year her vision was 0.4 and 0.45. At this time the protiodide was discontinued and she was given 1 c.c. of camirol subcutaneously twice weekly. One month later her vision had improved to 0.75 and 0.7. She was not seen for six months when the vision had decreased to 0.55 and 0.45.

The second case was that of a man, aged 70 years, with incipient lens opacities, arterio- and arteriolar retinal sclerosis, and perceptible macular depigmentation, whose vision was 0.3 and 0.35. Protiodide of mercury, gr. 0.25 thrice daily, was prescribed, and his vision slowly decreased to 0.1 in each eye in 13 months. His cataracts had not increased and all fundus details could be seen perfectly. The protiodide was discontinued and 1 c.c. of homiodin was injected subcutaneously twice weekly. He was not see for six months, but the treatment was continued. When he was again examined the cataracts had increased so that fundus details were seen with difficulty. He insisted that his cataracts be removed. With considerable reluctance this was done. Following surgery his corrected vision was 1.1 in each eye. For the past three-and-one-half years he has taken protiodide, gr. 0.25 thrice daily, at irregular intervals and his vision has varied from 1.1 to 0.9 in this space of time. When his vision decreases his medication is resumed, and each time his vision improves.

Conclusions

1. The conditions which produce senile macular degeneration are thought to be: (a) Senility, (b) heredity, (c) sclerosis of the choriocapillaris of the choroid. It is probable that heredity is the major factor in many instances, for it may predispose to either senility or to sclerosis of the choriocapillaris.

2. The administration of iodides did appreciably improve the vision in a majority of cases of senile macular degeneration in this series.

3. The mechanism by which this improvement is obtained is not known.

4. Large doses of iodides are not necessary to obtain satisfactory results.

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ERRORS IN DIAGNOSIS OF INTRAOCULAR TUMORS*

(SUSPECTED OR REAL)

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It is always a pleasure or satisfaction to report our successes in the treatment of any eye disease or good results after operations upon the eye.

A writer in the British Journal of Ophthalmology (June, 1943) makes a very truthful statement: "We have always held the opinion that one learns more from failures, our own as well as others, than from successes" and also adds "It always pays to listen to a patient's history, even if it may be very diffuse and to note the salient points in the history."

These truths will be evident in the history of the following cases.

Case 1. Mr. "A," aged 58 years, came for consultation on January 29, 1932, with the history of gradual failure of vision in the left eye for five years, during which time he was under the care of another oculist, who pronounced his condition as simple detachment of the retina. *Ophthalmoscopic examination* revealed a large, gray, smoothly rounded mass projecting far forward into the vitreous in the upper outer quadrant. There was an extensive detachment of the retina surrounding this mass, more elevated than the detachment elsewhere. With the pupil dilated it was possible to see all around the mass, which was very light, almost white in color. Transillumination showed a definite shadow. A diagnosis of "tumor" was made, and enucleation advised, and, because its color indicated that it was only mildly malignant, a favorable prognosis was given. The eye was promptly enucleated and the pathologist reported a spindle-cell sarcoma with very little pigment—evidently not a very malignant type. When the patient was seen in August, 1943, some 11 years later, he was perfectly well, so that he has probably passed the danger from any metastasis, and the mistake in diagnosis and delay in operation has had no serious result.

Case 2. Mr. "B," aged 55 years, was referred to us on July, 1943, with the history of sudden loss of vision in his right eye a week previously, and the request of information and advice concerning operation. He stated that 10 days previously, while working in his victory garden but doing no heavy lifting, he noticed the vision of this eye suddenly become blurred. *Examination* showed a large, smooth, rounded elevation in the upper portion of the fundus, sharply defined, with no folds, partly covering the nerve and entirely concealing the macula. The fundus was normal elsewhere. The elevation rose abruptly and was sharply defined on the temporal and nasal sides but had no sharp demarcation above—no retinal tear nor hole could be seen. Transillumination revealed no shadow. Tension was 14-16 mm. Hg (Schiøtz); vision was the perception of hand movements. A small disc could be seen above and to the nasal side, but the field was blind at fixation and below. Our diagnosis was a probable serous detachment of the retina, and we advised that the patient be put to bed in the hospital with complete rest, in the hope that the detachment might flatten so that it might be possible

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to see the hole or tear if such existed and then operate.

In February, 1944, six months later, the doctor reported that he had put the patient to bed as suggested, and as the detachment did not subside, he had performed a coagulation operation, following which the retina became reattached and vision improved. Two months later a new detachment occurred on the medial side of the former area, and the entire retina became detached. Several months later the patient reported to the doctor with "absolute glaucoma," tension 140 mm. Hg (Schiøtz). The eye was removed, and the pathologist found a "melanotic" sarcoma of the choroid near the optic nerve. This patient illustrates how impossible it may be in some cases to make a definite diagnosis of intraocular tumor in the very early stages.

Case 3. Mrs. "C," aged 42 years, from a nearby city, came for consultation on October 10, 1938, with various diagnoses from different doctors and finally with a diagnosis of intraocular tumor by the referring oculist. She had noticed some defect of vision in the right eye for four years, without change, but she thought it may have always been a poor eye. She had had some inflammation of both eyes eight years ago, which lasted four or five months, and she said that this recurs in the summer if she becomes overheated. There had been no pain in the eye until the past week. She was wearing: O.D. −0.50D. sph. ⊂⊃ −1.00D. cyl. ax. 165°; O.S. −0.75D. sph. ⊂⊃ −0.50D. cyl. ax. 180°. With these lenses her vision was O.D. 6/6, O.S. 6/5, and she could readily read 0.50 print with either eye. Muscle balance was exophoria 8 degrees and left hyperphoria 4. Four years ago she had been treated with radium and deep X-ray therapy for carcinoma of the cervix. She had been checked 10 months ago and pronounced all right and was due to return shortly for another check.

The pupils were equal and promptly reacted to light; tension was normal in each eye. *Ophthalmoscopic examination.* O.S., media clear, no pathologic changes in the fundus. O.D., with pupil dilated some vitreous opacities could be seen and some fine changes in the macula. Extending down and out from the macula there was a gray line and fold showing the beginning of a retinal detachment. This was not so sharply marked down and in. Directly below the nerve was a dirty-gray, indistinct, poorly outlined elevation or apparent growth, with several horizontal lines, like folds, over it. The vessels passing over it lacked the normal light reflex. The top of the elevation was plus 20 or more. No tear nor hole could be seen in the retina. Transillumination showed a very definite or dense shadow directly below. The tonometer recorded a tension of 15 mm. Hg. Our diagnosis was a probable intraocular tumor, and, from the history, we suspected it might be a carcinoma; hence made an unfavorable prognosis to the husband. As the patient was due for a check-up by the doctors who had treated her for the carcinoma of the cervix we advised that she see them promptly in order to determine the condition of the cervix—whether there had been any local recurrence at the seat of the original lesion and whether there was any indication of metastasis elsewhere. They reported that they found a rent far below, believed it to be a serous detachment, and advised trying operation. This was performed on October 24th. When the patient left the hospital a month later, the referring ophthalmologist wrote: "The retina appears to be completely reattached," and he was unable to see any definite evidence of tumor. "I have tried," he further wrote, "to make it clear to her that in spite of the at present suc-

cessful result of the surgery there is a remote possibility of a tumor showing up." She was seen by another oculist in this city in July, 1939, when there was pain in the left eye. His examination showed a deeply pigmented mass below with a definite shadow, detachment and wrinkling of the retina in the superior nasal area, and hemorrhage on the temporal side. He saw her again on April 9, 1940, a year and a half later, at which time she had what he thought was a large area of retino-choroiditis in the lower part of the fundus. Vision was 6/21.

It looks in this case as though we had been wrong in our diagnosis, but two questions arise in my mind: Will a serous detachment give a dense shadow in transillumination, and does the presence of a rent or hole in the retina exclude a tumor? Personally, I cannot see why in a detachment of the retina surrounding a growth there might not be a rent from the pulling upon or stretching of the retina. We have no subsequent history of this patient and know nothing of the remote possibility of a tumor showing, as the operating doctor suggested.

Case 4. Mrs. "D," aged 55 years, came from an adjoining city, on March 8, 1939, referred by an oculist from her home town who had found some serious trouble with the right eye. She reported a marked change in the refraction of this eye. As a result of her last examination she was wearing O.D., −1.50D. sph. ⊂⊃ −0.50D. cyl. ax. 180°; O.S., −0.75D. cyl. ax. 135° with a +2.00D. sph. added O.U. for reading. With these, vision was O.D. 5/5, O.S. 5/4, and accommodation was equal in the two eyes. External examination was negative. The pupils were equal, and reacted promptly to light. The tension was normal, and the field normal in each eye except for a slight contraction down and in, in the right eye. *Ophthalmoscopic examination* O.S. was normal. O.D. with pupil widely dilated there were seen many dustlike opacities in the vitreous; the disc was hazy but of good color. The fundus was normal except in the upper outer quadrant where there was a large prominent detachment of the retina with sharp lower border. The detachment appeared irregular, not smooth—no tear was seen. Transillumination showed a very definite shadow far back at the 11:30-o'clock position. The patient was seen again a week later. Vision did not seem to be so good. The appearance was practically as before—a prominent detachment up and out; directly out the lower horizontal margin of the detachment was sharply defined; up and in, it faded off irregularly into the surrounding retina. Transillumination showed a positive shadow as before. She was advised to see an oculist in another city for further opinion.

This doctor wrote that in his opinion, the patient had a serous detachment of the retina. He found the whole area translucent and could also see a tear in the retina. He operated upon the eye, shutting off the hole, and when she returned in May, two months later, her vision was 20/30 and the retina was in place. In June, in reply to my letter, the oculist who had originally referred her to us reported that up to the present time there is no evidence of a tumor and there is no further detachment.

Evidently, in this case, the error was in our office. There was definitely a difference of opinion in regard to a shadow and a retinal tear. Again the question arises about a serous detachment causing a shadow in transillumination and the importance of a tear in the differential diagnosis between a tumor and a simple detachment.

Case 5. Mr. "E," aged 27 years, was

seen in consultation, on December 31, 1921, in his bed at home. We were called by the physician's assistant. The patient had upon several occasions been fitted for glasses to correct some compound hyperopic astigmatism, with resultant normal vision, and had had no trouble otherwise with the eyes. Three or four days before we saw him, he had noticed a blur before his left eye, which came on rather suddenly without any apparent cause. There was no history of injury to the eyes or head nor of any physical strain. He had been using the eyes only moderately. The assistant saw him on the day the blur was first noticed, and made a diagnosis of detachment of the retina. The pupils were widely dilated with atropine; vision sufficed only to count fingers at a short distance. The field was contracted almost to fixation in all directions. Tension was normal or slightly less than in the right eye. *Ophthalmoscopic examination,* O.D., disclosed nothing pathologic; a low hyperopia. O.S., the media were clear; the disc was round, more hazy than in the right eye, especially at the inner edge, hyperemic, and the retina striated. Directly above was a large smooth regularly rounded mass projecting far forward into the vitreous. It rose very abruptly, the vessels could be seen passing over it. There was no detachment, fold, nor irregularity in the retina surrounding it. Transillumination directly above and well posterior showed a very definite dark shadow, whereas to either side of it and from all other directions there was good illumination. A diagnosis of probable sarcoma of the choroid was made, and the patient was advised to have another examination by his regular oculist, who was returning very shortly, and if our findings were confirmed, to have the eye enucleated. His oculist considered it a simple detachment and made a scleral puncture. He reported on December 18, 1922, almost a year later, that the eye had steadily improved after the operation, but we had no opportunity to make an examination. Later, when the patient was having some discomfort, he consulted another Cleveland oculist who found the tension increased and sent him to an oculist in another city, who, in late 1924 or early 1925, trephined the sclera over the site of the lesion. Later he was seen by a still different oculist in Cleveland, who found a well-marked nodular mass in the vitreous and tension 34 mm. Hg, with slight discomfort. He made a diagnosis of intraocular growth and advised enucleation. The patient returned to the oculist who had trephined the eye the year before, and in January, 1926, this oculist removed the eye and found a tumor within the globe. He informed the patient that the tumor was of very recent growth, although I had made the diagnosis of it four years previously. Unfortunately, I do not know what type of tumor the pathologic examination revealed. We saw the patient for simple conjunctivitis in the right eye in 1927, and at that time there was no sign of metastasis elsewhere, a danger which, I felt, had naturally been increased by the long delay. The interesting feature of the case was the long interval between the time when we first saw him and made the diagnosis of the intraocular tumor, and the time when the eye was finally enucleated—a period of more than four years. When we last talked with him over the telephone in 1944, 18 years later, he was in good health, so that evidently the tumor was of the non- or low-malignant type.

Case 6. Miss "F," aged 18 years, accompanied by her father, a physician, first consulted us in January, 1927. There was a history of forceps at birth and a contusion of the right upper lid. When she was four or five years old, the parents

noted a slight squint. She was taken to an oculist who told them that the eye was blind. The slight squint continued and varied at times, being more marked when she was tired or not well. She had a strenuous time during the Christmas holidays, attending parties, and spent several days in bed. Upon returning to school she was again in bed for several more days and the nurse noticed the pupil of the right eye was larger than the left. She began having some inflammation and pain in the eye. This became so severe one night that the following morning she consulted a local oculist who told her that he suspected a "neoplasm" in the eye. She returned home at once and was brought to the office.

Examination showed vision in the right eye to be light projection; O.S. 6/5. There was marked strabismus in the right eye with limitation of outer movement. All other movements were normal. The iris was slightly discolored, with several large vessels on the surface and ectropion of the iris pigment around the entire pupillary margin. The pupil was widely dilated above, while below there was a broad posterior synechia; only slight bulbar conjunctival injection. By oblique light, some slight reddish reflex could be made out on the extreme nasal side with numerous glistening spots like cholesterin crystals giving it a mottled appearance; all seen best with a strong plus sphere. A gray reflex showed through a veil directly above, while far to the outer side and above was a gray reflex like extensive exudate with several vessels over it. Directly in the center and below there was no red reflex, only a dense opacity. The slitlamp confirmed these observations. The anterior layers of the cornea were clear; on the posterior surface were a very few fine pigment dots and a few smaller dots on the anterior capsule of the lens. The lens itself showed nothing abnormal. A fine, apparently organized, semitransparent film could be seen in the vitreous with a large denser mass on the nasal side, blood color. To the outer side the vitreous was more gray or more densely organized with even darker spots, some brown, some slightly reddish, but no definite mass could be distinguished.

Transillumination showed a dense shadow over this area, and good red reflex from all other directions. Oblique light showed a grayish mass with some reddish spots in the lower portion of the fundus. The tonometer reading was 44 mm. Hg (Schiøtz).

On the day following, her first visit, I learned that on the day before she first noticed this eye trouble, she had had a fall while skiing and struck the right side of her body and head. This suggested the possibility of an intraocular hemorrhage. I also learned from her oculist, who had seen her in childhood, that ophthalmoscopic examination at that time showed all media clear and an extensive rupture of the choroid involving the macular region with much disturbance and atrophy of the choroid throughout the fundus. Only two years before I saw her, the vitreous, he reported, was clear and there was no sign of iritis. Hot packs were ordered. There was no change the following day, the tension was still 44 mm. Hg. The patient was advised to continue the hot packs, keep quiet, and report. Three days later she was having no discomfort whatever and examination showed no change. Potassium iodide was added to the treatment and the hot packs continued. Four days later she was having no discomfort. Ophthalmoscopic examination showed the same general appearance except that the vitreous was not so dense and more red reflex could be seen in the periphery below, in and out. Transillumination showed the same shadow. I had felt that

the condition was most probably due to an intraocular hemorrhage from the fall and was treating her accordingly. Her age also pointed against the probability of a tumor. The father decided he would like a consultation, to which I gladly acceded, and gave him a letter explaining that the present trouble seemed to have started as the result of a fall in skiing and the history would suggest an intraocular hemorrhage (though other symptoms pointed to an intraocular growth). The interior had shown no change except that the vitreous did not appear so dense as at the first visit and all pain had ceased.

The father took her to another oculist and apparently did not show my letter suggesting an intraocular hemorrhage. Finding a detached retina, dense shadow in transillumination and increased tension, and without the history of the probable cause of onset, the importance of which I stressed in the letter, he concluded it was an intraocular growth and removed the eye the following morning. The father wrote me "there was a growth and I heard some talk of a secondary glaucoma." I was still unwilling to accept this diagnosis, and in March, 1935, eight years later, I finally received a report on the pathologic findings. These showed: "No tumor but a subretinal space filled with a large blood clot containing many cholesterin crystal spaces, and absolute glaucoma." Possibly no other treatment than enucleataion would have given her permanent relief, but our original diagnosis of intraocular hemorrhage rather than intraocular tumor was confirmed.

This case illustrates the importance of a careful history in arriving at a correct diagnosis. Later I had the satisfaction and pleasure of informing the father, who had never received a report of the pathologic findings, that he need have no further anxiety about the possibility of metastasis.

Case 7. In this last case to be presented there was no error in the diagnosis but rather a mistake on the part of the patient in not consenting to enucleation when first seen.

Mrs. "G," aged 57 years, came for consultation on September 14, 1908. Vision was O.D. 6/30; O.S. 6/7.5. Five or six weeks previously she had noticed a blur before the right eye on the temporal side. *Ophthalmoscopic examination* revealed an extensive detachment of the retina up and in, with a dense shadow on transillumination. The eye appeared normal externally. There was no discomfort. Tension was normal. The patient was told of the tumor and enucleation was advised, but she was not willing to have the operation. After several subsequent visits, with symptoms each time becoming more evident, she finally consulted us again on March 13, 1909, six months later, when she was having some discomfort and no light perception. Examination showed only red reflex and no view of the fundus. She then consented to the operation and the eye was promptly removed.

The pathologist reported a pigmented spindle-cell sarcoma of the choroid and gave a guarded prognosis as to recurrence.

Four and one-half years later she was reported at Charity Hospital, with extensive growth on the liver—evidently metastasis.

The question arises in this case, whether there might have been a different final outcome if she had consented to the operation six months earlier, at the time of her first visit.

The Guardian Building.

SOME OBSERVATIONS UPON THE CHEMICAL NATURE OF THE PTERYGIUM*

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New Orleans

Merigot de Treigny and Coirre[1] define the pterygium as follows: "An ocular disease which is characterized by a membranous growth on a level with the bulbar conjunctiva. It is opaque, more or less vascular, habitually triangular, and generally situated in the palpebral aperture. The body spreads fanlike and is movable on the sclerotic which it covers (cf. fig. 1). The disease can lead to blindness by a total encroachment over the pupillary zone and frequently recurs when operated upon."

A complete description of the disease is given by these French ophthalmologists. Duke-Elder[2] stated that the "fully developed pterygium is covered with conjunctival epithelium, stratified with flat cells on the surface of the head and neck. Goblet cells are numerous in the depressions which form glands which may develop into cysts. Throughout the epithelial layer there may be pronounced pigmentation. The stroma is similar to normal sub-epithelial tissue. It is dense and cellular near the apex, elastic fibers are numerous, and patches of amyloid and hyaline degeneration are usually evident" (cf. fig. 2).

Fuchs was probably the only early investigator who made an attempt to study the chemical nature of the stroma of the pterygium. He observed that the hyaline substance was characterized by its homogeneous character, its refractive power, its resistance to acids and alkalies, and by its deep staining with carmine, picro-carmine, and with eosin.

Pterygia are frequently observed on the Ophthalmologic Service of the Charity Hospital. If choline chloride is topically applied to the pterygium its head will become altered.[3] For this reason it was deemed advisable to attempt a study of the chemical make-up of these pathologic growths. Our tests were few, due to the limited amount of material available.

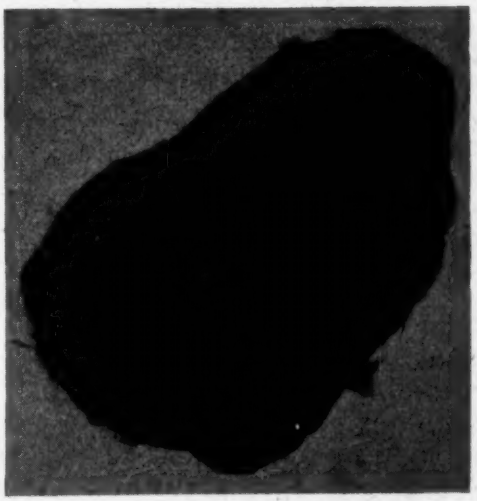

Fig. 1 (Beard and Dimitry). A pterygium.

Three pterygia, very soon after surgical removal from the eye, were boiled out with chloroform in a beaker of hot water. The Salkowski reaction for cholesterol ($CHCl_3 + H_2SO_4$) was very faint but deepened on standing for one or two days. Precipitation with digitonin was unsuccessful owing to the minute amount of cholesterol present. The amount of chloroform-soluble material present in the fresh pterygia is given in table 1.

Our balance was sensitive to about ± 1 mg. For this reason the figures in the second decimal place in the table are estimates. The presence of about 50 percent of the pterygium as chloroform-

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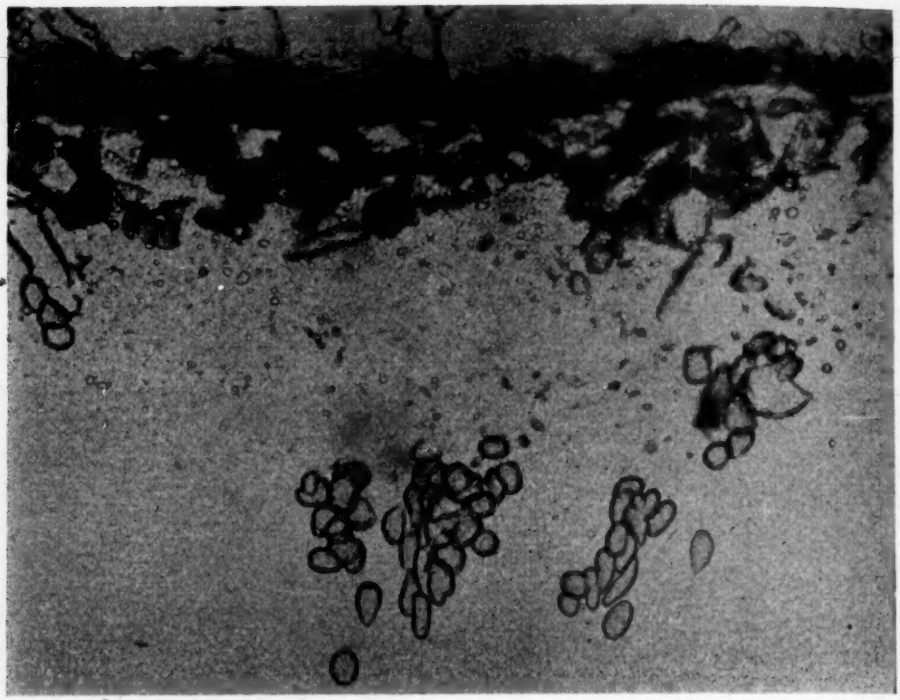

Fig. 2 (Beard and Dimitry). Border of pterygium showing granular deposits soluble in chloroform (× 400).

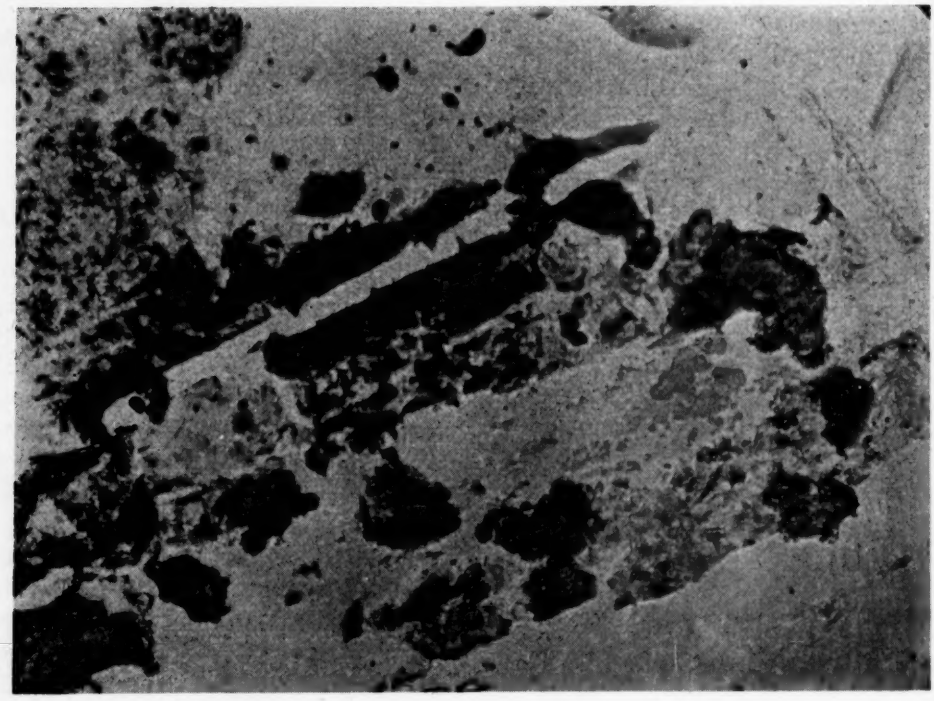

Fig. 3 (Beard and Dimitry). Chloroform-soluble material (fat, fatty acids, and cholesterol) from the pterygium (× 400).

soluble material, possibly fat and fatty acids, is of much interest in relation to the effect of choline chloride* in causing these growths to disappear. Soon after applying solid choline chloride topically to the head of the pterygium, *changes*

TABLE 1

CHLOROFORM-SOLUBLE MATERIAL PRESENT IN FRESH PTERYGIA

Sample No.	Weight mg.	$CHCl_3$ Soluble Material mg.	Residue mg.
1	6.6	2.9	3.7
2	7.7	3.2	4.5
3	9.2	5.1	4.1
Average	7.8	3.7	4.1

occurred. The blood vessels of the body of the growth became greatly engorged with blood and the fatty substances disappeared. Evidently the formation and transportation of phospholipids occurred here as is the case when choline removes the fatty material from liver (its lipotrophic action).[4] From these results one may be justified in asking the question, "Is the formation of the pterygium due to a choline deficiency in adults?" This is possible since choline gives dramatic results and the irritation theory of the formation of the pterygium is no longer held.[3]

A photomicrograph of the original pterygium is shown in figure 1 and its border in figure 2. Figure 3 shows the residue obtained of the chloroform-soluble material stained with Sudan III. Figure 4 shows the transparent residue left of the pterygium after chloroform extraction.

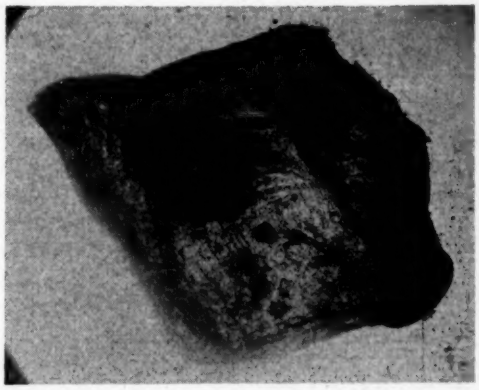

Fig. 4 (Beard and Dimitry). Pterygium after boiling with chloroform.

* Choline chloride of Merck and Company.

SUMMARY

Three pterygia were studied after surgical removal. Their average weight was about 8 mg. The chloroform-soluble material amounted to about 47.5 percent of the fresh weight of the growth. A positive Salkowski reaction for cholesterol was obtained, but the amount present was too small to be precipitated with digitonin. The action of choline chloride in causing these growths to become altered is discussed together with a new etiology of the disease.[5, 6, 7]

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BACTERIOLOGIC STUDY OF HUMAN CONJUNCTIVAL FLORA*

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The bacterial flora of the human conjunctiva has been studied in Europe and elsewhere from the beginning of this century, and has also been the object of intensive research in the eastern, southern, and central sections of the United States. To our knowledge, however, such a program has never before been undertaken on the Pacific Coast, and the survey made by the Department of Ophthalmology and the Clinical and Research Laboratories of Mount Zion Hospital in San Francisco, therefore, is the first to be reported in this area.

It is known that the conjunctiva of the newborn is normally sterile, and that it later becomes subject to invasion by bacteria. Classification of these organisms into pathogenic and nonpathogenic for the conjunctiva has been more or less well established. The intact ocular mucous membrane is protected histologically by its tissue structure, mechanically by the cleansing action of winking, and chemically by antibodies and the bactericidal properties contained in tears, chiefly from lysozyme. It is interesting to note that lysozyme, an enzyme, was first described in 1922 by Alexander Fleming, who, in 1929, discovered penicillin.

In the presence of reduced tissue resistance due to trauma or abnormality, however, such organisms may invade the conjunctiva, colonize there, and produce local inflammation or infection. Some types of conjunctivitis can be adequately diagnosed clinically. However, the exact etiology of others is determined only by bacteriologic study of conjunctival scrapings. A microdiagnosis so obtained is often of inestimable value in making possible the correct diagnosis, a more accurate prognosis, and institution of proper treatment. It is also a vitally important preliminary measure in planning intraocular operations. A normal-appearing conjunctiva may be discovered to harbor flora which, though nontoxigenic to the sound conjunctiva, may prove toxigenic to the anterior chamber into which they are likely to be carried by the surgeon's knife. With this information available, appropriate prophylactic therapy can be effected. Since we are limiting this paper to bacteriologic observations, treatment will not be discussed here.

Our analysis is based on bacteriologic findings in 152 cases of clinically normal conjunctivas and acute and chronic conjunctivitis from birth to 80 years of age. Although our results substantiate for the most part those published by early authors, improved knowledge of bacteriology and modern methods of culture have yielded a number of microörganisms rarely recorded as residing on the human conjunctiva. They have also proved the absence of certain others, such as the Koch-Weeks and Morax-Axenfeld bacilli. Our statistics conform quite closely to those from other communities, with the noteworthy exception that the pneumococcus was isolated from only two of our patients.

* From the Department of Ophthalmology and the Clinical and Research Laboratories of Mount Zion Hospital, San Francisco. This research was aided by a grant from the Columbia Foundation. Read before the Section on Eye, Ear, Nose, and Throat, at the Seventy-third Annual Session of the California Medical Association, Los Angeles, May 8, 1944.

Technique

Our technique of bacteriologic study was as follows:

Culture methods. The conjunctiva and cornea were anesthetized with repeated instillations of 0.5-percent pontocaine. Topical scrapings were made of the palpebral and bulbar conjunctiva with the aid of a platinum spatula (fig. 1). A small sterile swab, moistened with sterile broth, was also used for collecting material. Culture media were inoculated first, and the scrapings were carefully placed on glass slides and stained by Giemsa and Gram stains.

Depending upon the type of infection suspected, media were selected that were suitable for the growth of various bacteria, both anaerobic and aerobic, and fungi. Cultures were inoculated at both 37° and 22°C., since the latter more closely approximates the temperature of the conjunctiva.

The routine medium employed contained Difco proteose peptone (No. 3) and 5-percent rabbit's blood. For the purpose of promoting the growth of hemoglobinophilic bacteria, cooked blood agar was used. The anaerobic bacteria were cultivated in tubes of thioglycolate broth, and also on blood agar in Spray dishes. Heart infusion broth was used as a duplicate to permit development of aerobes, and Loeffler's slants for the isolation of the Morax bacillus and related organisms. Cornmeal agar served for the growth of fungi.

The material removed by scraping was diluted serially, and some of it was exposed for 10 to 15 minutes to the action of an aqueous solution of 1 to 20,000 to 1 to 40,000 crystal violet (to permit intrinsic bacteriostasis of a variety of Gram-positive bacteria) before being cultured. The remainder was inoculated directly into the aforenamed media.

Fig. 1 (Rodin). Platinum spatula used to obtain scrapings from the conjunctiva.

Animal inoculation. For the detection of the virus of herpes, some of the material removed from the patient was inoculated into the scarified cornea of a rabbit. The pathogenicity of organisms isolated was tested by subconjunctival and

TABLE 1

Bacterial flora of normal conjunctiva*

Age Group	No. Cases Cultured	No Growth	Staphylococcus		Diphtheroids	Streptococcus		More than 1 Organism
			Non-toxigenic Coagulase Negative	Toxigenic Coagulase Positive		Nonhemolyticus	Hemolyticus	
10–20	9	2	6		6			5
20–30	7	2	5		3			3
30–40	6	2	4		1			1
50–60	5	2	3		1			1
60–70	7		5	1	6			4
70–80	8		4	3	4			2
	42	8 (20%)	27 (76%)	4 (10%)	21 (50%)	0	0	16 (40%)

* There was also one case of Alcaligenes in a patient 65 years of age and one case of Streptococcus viridans in a patient 49 years of age.

TABLE 2

BACTERIAL FLORA OF ACUTE CONJUNCTIVITIS*

Age Group	No. Cases Cultured	Staphylococcus		Diphtheroids	Streptococcus		Miscellaneous Organisms
		Nontoxigenic Coagulase Negative	Toxigenic Coagulase Positive		Nonhemolytic	Hemolytic	
0– 1	13	5	1	5	1		4
10–20	1	1	1	1		1	
20–30	4	3		3	1		2
30–40							
40–50	2	1		2			1
50–60	2	1	1	1			1
60–70	3	2	2	1			2
	25	13	5	13	2	1	10

* There were 5 cases of inclusion blennorrhea in newborn infants, 1 Streptococcus viridans, and 1 pneumococcus, type III. One case of B. pandora, 1 of Sarcina, 1 of pseudomonas, 2 of Alcaligenes, and 1 of Gaffkya tetragena were discovered.

intraocular injection of similar animals.

Serologic tests. When lymphogranuloma venereum or gonococcal infection was suspected, the patient's serum was subjected to complement-fixation tests. Agglutination reactions were performed for the diagnosis of brucellar or leptospiral infections.

BACTERIAL FLORA OF NORMAL CONJUNCTIVA

Cultures from 42 clinically normal conjunctivas were examined bacteriologically. To these patients' knowledge, and according to their case histories, they had had no ocular disturbances. The organisms most commonly recovered were staphylococci (76 percent) and diphtheroids (50 percent), usually in combination. The parallel incidence of these two bacteria was seen to be lowest at an age between 20 and 40 years, highest in the 50-to-60-year age group, and to remain consistently elevated thereafter. Mixed cultures were fairly uniform in incidence throughout the span, and were noted in 40 percent of all eyes examined. These findings vary insignificantly from those of Khorazo and Thompson,[1] who report an increase in diphtheroids and mixed cultures in direct ratio with the age of the patient, particularly accentuated in the 30-to-49-year classification (38 percent). Alcaligenes was present in one case and Streptococcus viridans in another. No Streptococcus, pneumococcus, or Sarcina was isolated. Occasionally in these eyes, bacteriologic study fails to reveal any growth whatsoever, but this is a rare occurrence (8 out of 42 cases, 20 percent). On the other hand, many organisms may be present on conjunctivas exhibiting no clinical evidence of inflammatory reaction. This is particularly true of Staphylococcus, which is known to be an inhabitant of most normal conjunctivas. Some strains of both Staphylococcus aureus and Staphylococcus albus are considered toxin producing and others nontoxin producing,[2] and the object of bacteriologic examination is to determine which strains are present in a given eye.[3] In our experience, the coagulase test yields the most reliable results. The problem of diphtheroids has been studied, and a report of the findings is now in the process of publication.

Bacterial flora of acute conjunctivitis

Twenty-five cases were studied. Here as in clinically normal eyes, Staphylococcus and diphtheroids predominate. In addition, Streptococcus nonhaemolyticus appeared twice, and Streptococcus haemolyticus once in 25 patients. An unusual finding was that of B. pandora. A scraping from a rubber plant owned by the patient revealed an identical growth. A single case each of Sarcina, pseudomonas and Gaffkya tetragena, and two cases of Alcaligenes were present. Only one case of pneumococcus was isolated in an infant, whereas in Thygeson's[4] report this organism was the most frequent source of infection in acute and subacute conjunctivitis in Iowa. In San Francisco,[5] the Staphylococcus aureus, hemolytic and toxigenic, seems to be the most frequent etiologic agent in conjunctivitis of a certain clinical type.

The bacteriologic examination in conjunctivitis of 13 newborn infants revealed 5 cases of inclusion blennorrhea.

TABLE 3

Bacterial flora of conjunctivitis of the newborn

Name	Age	Clinical Data	Bacteriologic Observations
1. T.	5 days	5 days after birth, child showed purulent discharge from both eyes; father had gonorrheal urethritis; mother had vaginal abscess during pregnancy.	Vaginal smear of mother negative; scrapings from baby's tarsal and bulbar conjunctivas showed epithelial-cell inclusions characteristic of inclusion blennorrhea; no bacteria on smear or culture.
2. J.	21 days	13 days after birth, swelling and discharge, left eye; right eye involved; 8 days later, lids edematous and red; purulent secretion.	Cytoplasmic bodies characteristic of inclusion blennorrhea; Staphylococcus albus nontoxigenic.
3. P.	3 days	3 days after birth, purulent secretion from right eye.	Smear, few epithelial cells, no bacteria nor inclusion bodies; culture, several colonies of Staph. albus, occasional colonies of Str. nonhaemolyticus and Str. viridans, also a few diphtheroids.
4. M.	23 days	Purulent discharge from right eye.	Gram stain, many pus cells, no bacteria, no inclusion bodies; culture, Staph. albus and a few diphtheroids.
5. T.R.	11 days	Purulent discharge from left eye.	Smear, gram-positive cocci and leucocytes, also few gram-negative rods; culture, Staph. aureus haemolyticus.
6. N.	2 days	Purulent discharge from both eyes.	Smear, epithelial cells, diphtheroid bacilli, no inclusion bodies; culture, Staph. albus and diphtheroids.
7. G.	2 days	After birth, greenish discharge from both eyes.	Culture, Staph. albus haemolyticus, Staph. aureus and diphtheroids.
8. K.	2 days	Conjunctivitis, left eye, at birth; eczema of face.	Direct smear, no bacteria; culture, Staph. aureus.
9. C.T.	7 mos.	Infection began 3 days after birth, with purulent discharge.	Pneumococcus, type III.
10. C.	1 day	2 hours after birth, swelling and discoloration of upper lids, especially of left eye; purulent secretion.	Direct, smear, numerous white blood cells; culture, no growth.
11. Z.	2 mos.	10 days after birth, lids were sticking with secretion. Conjunctiva red.	Inclusion bodies suggestive of inclusion blennorrhea.
12. W.	5 wks.	Discharge right eye for 1 wk. Eyelids swollen.	Typical inclusion bodies present and diphtheroids.
13. L.	14 days	Left eye red with discharge; difficulty in opening eyelids.	Inclusion bodies suggesting inclusion blennorrhea.

This infection of the newborn is caused by a filtrable virus, and is a distinct clinical entity occurring acutely 5 to 10 days after birth. It is very important to differentiate microscopically between inclusion blennorrhea of the newborn and ophthalmia neonatorum of gonococcal origin.[6] These infants were seen in an acute stage of the disease, and showed severe inflammation, edema, and infiltration of the conjunctiva, and purulent discharge. It is interesting to note that in one case the father had a gonorrheal urethritis, and the mother a vaginal abscess during pregnancy.

Other bacteriologic findings in the newborn are described in table 3.

TABLE 4

BACTERIAL FLORA OF CHRONIC CONJUNCTIVITIS*

Age Group	No. Cases Cultured	Staphylococcus		Diphtheroids	Streptococcus		Sarcina	Miscellaneous Organisms
		Nontoxigenic Coagulase Negative	Toxigenic Coagulase Positive		Nonhemolytic	Hemolytic		
1–10	4	1	2	3		1	1	1
10–20	7	5	2	4	1			
20–30	10	7	4	5			2	1
30–40	21	15	9	10			1	3
40–50	12	9	5	7			2	2
50–60	13	10	2	9			4	2
60–70	13	9	8	10			1	2
70–80	5	3	2	2				
	85	59	34	50	1	1	11	11

* There were 2 cases of lymphogranuloma venereum; 2 of trachoma; 5 of Gaffkya tetragena; 1 of Alcaligenes; 1 of Haemophilus influenzae; 1 of Bacillus subtilis; 1 of Micrococcus catarrhalis; 1 of Micrococcus mutabilis.

BACTERIAL FLORA OF CHRONIC CONJUNCTIVITIS

Eighty-five cases of chronic conjunctivitis were studied. Staphylococcus and diphtheroids still dominate the picture, and their incidence increases with advancing age. The Streptococcus was recovered only twice, but Sarcina and Gaffkya tetragena were quite constant in a small proportion of eyes from one through 60 years. Haemophilus influenzae, Bacillus subtilis, Micrococcus catarrhalis, and Bacillus mutabilis were isolated once each from patients 40 to 70 years of age. Children are usually free from chronic conjunctivitis. A five-year-old child was the youngest to be affected in this series.

Culture study in chronic conjunctivitis is at times of tremendous value in diagnosing the underlying cause.[7] For example, a patient proving refractory to treatment for conjunctivitis was referred for bacteriologic examination. Microscopic study of the growth from conjunctival scrapings revealed trachoma as the primary infective agent, and Staphylococcus secondary. Staphylococcus is frequently superimposed in trachoma infections, and the latter should be suspected in long-standing cases. Our patient was a 52-year-old woman who worked in a clinic as a nurse's aide, treating Indians who were infected with trachoma. Laboratory findings showed Staphylococcus aureus haemolyticus and diphtheroids. Inclusion bodies suggestive of trachoma were found. The second patient was a man, aged 72 years, with chronic conjunctivitis

TABLE 5

BACTERIAL FLORA OF CONJUNCTIVAS PRIOR TO CATARACT EXTRACTION

	Name	Age	Eye	Bacteriologic Findings
1.	C.F.	74	R.E.	Staph. albus nonhaemolyticus.
2.	G.M.	60	L.E.	One colony of Staph. albus nonhaemolyticus; 50–100 colonies diphtheroids.
3.	A.O.	61	R.E.	Few colonies Staph. albus hemolyticus; diphtheroids.
4.	B.H.	54	R.E.	Staph. albus haemolyticus, nontoxigenic. Staph. aureus haemolyticus, nontoxigenic.
5.	A.M.	40	L.E.	No bacterial growth.
6.	M.M.	65	R.E.	Staph. aureus nonhaemolyticus; diphtheroids.
7.	A.N.	48	R.E. Tabes	No bacterial growth.
8.	A.N.	49	L.E. Tabes	3 colonies of Str. viridans and diphtheroids. Some colonies Staph. albus.
9.	L.R.	36	R.E. Myotonia dystrophia	Several colonies of Staph. albus.
10.	L.R.	37	L.E. Myotonia dystrophia	Several colonies of Staph. albus.
11.	H.S.	38	L.E.	One colony Staph. albus.
12.	D.F.	52	L.E. Injection of bulbar conjunctiva	Profuse growth of Staph. albus, nontoxigenic. Following treatment no growth 10 days later.
13.	J.M.	72	L.E.	Staph. aureus haemolyticus, toxigenic; 100 colonies. Following treatment, 20 days later 1 colony Staph. aureus haemolyticus, toxigenic.
14.	A.R.	64	L.E.	Cataract extracted from right eye elsewhere with vision 20/30. 6 years later eye became red with hypopyon, panophthalmitis developed, eye enucleated. Left eye scheduled for surgery. Clinically conjunctiva normal, culture showed 150 colonies Staph. albus (nonhemolytic) and 50 colonies diphtheroids. Operation postponed. 4 days later acute conjunctivitis developed. 2 months later culture revealed 25 colonies Staph. albus and 8 diphtheroids. Month later culture showed few colonies of Staph. albus. Preliminary iridectomy done. 6 days after operation eye became red with purulent discharge from conjunctiva. This cleared up. Later cataract extracted without complications.
15.	E.E.	82	L.E.	Staph. albus and aureus haemolyticus, numerous. After treatment, 20 colonies Staph. albus and 2 colonies Staph. aureus haemolyticus; 6 colonies diphtheroids.
16.	G.O.	70	R.E.	Cataract removed without culture study, followed by infection. Dense membrane formed. Before discission, few Staph. albus nonhaemolyticus. Vision obtained 20/40.
17.	E.B.	71	L.E. Simple glaucoma with trephining Eyeball injected	Three colonies Staph. albus.
18.	C.D.	69	L.E.	One or 2 colonies Staph. albus.
19.	M.B.	82	L.E.	Three colonies Staph. aureus haemolyticus, toxigenic. As the conjunctiva was clinically normal, patient was hospitalized. During the night, the eye became red. Culture taken 10 days later showed few colonies of Staph. aureus. Rehospitalization; eye again became red. Culture study later showed 80 colonies of Staph. aureus haemolyticus. Treatment. Cultures showed no growth.
20.	W.L.	63	R.E.	Few colonies Staph. albus.
21.	A.M.	41	R.E.	No bacterial growth.

of one year's duration. Cultures revealed Escherichia coli and a nonhemolytic Streptococcus not corresponding to Lancefield's groups A, B, and C. Suspicious-looking inclusion bodies suggesting trachoma were present.

The two cases of lymphogranuloma venereum are of interest. These occurred in Negroes 32 and 33 years of age, in whom a clinical diagnosis of chronic conjunctivitis, corneal ulcers, and hypopyons had been made. Complement fixation with psittacosis antigen indicated the presence of lymphogranuloma-venereum infection. Cultures yielded hemolytic and nonhemolytic staphylococci.

Bacterial study of conjunctiva prior to cataract extraction

There is no uniformity of opinion as to whether or not a bacteriologic study of the conjunctiva should be made before cataract extraction. Some surgeons hold that if the eye is clinically normal and there is no obstruction to the nasolacrimal apparatus, the eye may be considered safe for operation. If the eye is not clinically normal, and if under treatment the infection cannot be cleared up, a culture study is then of value to determine whether bacteriologic conditions make operation a safe procedure. Others prefer to have bacteriologic studies made prior to every intraocular operation.

Browning,[8] who has made an extensive bacteriologic study of eyes at the Moorfields Hospital, emphasizes the importance of a preoperative bacteriologic study. "Bacterial infection is one of the causes of failure following the operation of cataract extraction. It was the cause of the loss by removal of about 1 per cent of the eyes operated on for cataract at Moorfields. . . . With modern bacteriological methods, most, if not all of these cases could be avoided, and I think that if all conjunctival sacs were bacteriologically examined before operation there would be fewer postoperative infections, or infections during the operation."

Our policy has been to advise postponement of cataract extraction when six or more colonies of Staphylococcus haemolyticus toxigenic, or two or more of Streptococcus haemolyticus, pneumococcus, or Bacillus pyocyaneus are present.

Table 5 presents data on 21 consecutive cases of cataract, of which 20 were studied bacteriologically before extraction. Of these, 18 had clinically normal conjunctivas. In 16 cases, there was either no growth or only a few colonies—not sufficient to justify postponement of the operation. Case 13 showed 100 colonies of Staphylococcus haemolyticus toxigenic, which cleared up under treatment.

Case 14 is of interest. A cataract was extracted from the right eye, with vision obtained of 20/30. Six years later the eye became red with hypopyon. Panophthalmitis developed and the eye was enucleated. One year later the left eye was scheduled for a cataract extraction. Clinically the conjunctiva was normal. However, a culture showed 150 colonies of Staphylococcus albus (nonhemolytic) and 50 colonies of diphtheroids. The operation was postponed. Four days later the patient developed an acute catarrhal conjunctivitis. Two months later a culture revealed 25 colonies of Staphylococcus albus and 8 of diphtheroids. One month later culture showed only a few colonies of Staphylococcus albus. A preliminary iridectomy was done. Six days after the operation the eye became red and there was a purulent discharge from the conjunctiva. This cleared up. The patient was treated with autogenous Staphylococcus vaccine. Later cultures showed a few colonies of Staphylococcus, and the cataract was extracted, without complications.

The patient in case 15 had numerous

colonies of Staphylococcus aureus and albus haemolyticus, which also disappeared under treatment.

Case 19 was that of an obese female, 82 years of age, who had bilateral cataracts. Culture study showed three colonies of Staphylococcus aureus haemolyticus toxigenic. As the colonies were few, and the conjunctiva was clinically normal, she was hospitalized. During the night the eye became red. Culture taken 10 days later showed a few colonies of Staphylococcus aureus. She was again hospitalized, and during the night the eye again became red. Culture study later showed 80 colonies of Staphylococcus aureus haemolyticus. The eye was treated, and subsequent cultures showed no growth. There was no infection following cataract extraction.

There were two eyes which clinically showed injection of the conjunctiva. Case 12 displayed a profuse growth of Staphylococcus albus nonhaemolyticus. Ten days later, following treatment, there was no growth.

Case 17 was of a patient who had simple glaucoma of the left eye where a trephining had been done. After the trephining, the tension remained normal. Adhesions between the iris and the lens took place, and a secondary cataract formed. The eyeball appeared to be injected. The culture showed three colonies of Staphylococcus albus. In view of the few colonies present, it was felt safe to extract the cataract. This was done without subsequent infection.

The patients in all cases reported here were operated upon without infection following cataract extraction, with the exception of case 14 and case 16. In case 14 there was a purulent conjunctivitis six days after a preliminary iridectomy. In case 16 the cataract was extracted without a previous culture study having been made. Postoperatively, an acute iritis developed, with the formation of a dense membrane. Nine months later, culture showed a few colonies of Staphylococcus albus nonhaemolyticus, and discission was done. Vision obtained was 20/40.

Summary

1. Bacteriologic study of the conjunctiva is of inestimable value in the diagnosis, prognosis, and treatment of infection of the conjunctiva, especially of clinically obscure conditions. It is important in determining the safety of operation on potentially infected eyes presenting cataract.

2. An analysis of 152 cases including persons with normal conjunctivas, acute and chronic conjunctivitis, and precataract-extraction conjunctivas so studied is presented. Bacteriologic investigation of conjunctival scrapings was carried out by the technique described.

3. The organisms most commonly recovered from clinically normal conjunctivas were Staphylococcus aureus and albus, hemolytic and nonhemolytic, toxigenic and nontoxigenic, and diphtheroids. More than one organism was present in almost half the cases. Notable was the absence of Koch-Weeks and Morax-Axenfeld bacilli.

4. Certain clinical types of acute conjunctivitis in San Francisco are marked by the predominance of Staphylococcus aureus (hemolytic and toxigenic), and of diphtheroids. Cultures demonstrated five cases of inclusion blennorrhea of the newborn. A single case of pneumococcus, type III, was discovered in an infant.

5. In chronic conjunctivitis, Staphylococcus and diphtheroids are the most frequent findings, increasing in incidence with advancing age. Two cases of trachoma and two of lymphogranuloma venereum, referred with a diagnosis of chronic conjunctivitis, were diagnosed with the

aid of laboratory procedures. Staphylococcal infection was superimposed in all.

6. Twenty-one consecutively studied cataract cases are reported. Of these, 18 patients had clinically normal conjunctivas. Sixteen of them showed no growth, only a few colonies, not enough to justify postponement of the operation. Three showed many colonies, which, under treatment, cleared up, and the operation was done without the development of an infection. The only case in which an infection occurred following the cataract extraction was in a patient who clinically had a normal conjunctiva, and a culture had not been done previous to the operation.

It would seem advisable to postpone an operation in the presence of six or more colonies of Staphylococcus haemolyticus (toxigenic), or two or more of Streptococcus haemolyticus, pneumococcus, or Bacillus pyocyaneus.

We wish to thank Anna C. Riis and Marian C. Shevky for their bacteriologic assistance.

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NOTES, CASES, INSTRUMENTS

ANTERIOR MEGALOPHTHALMOS AND ARACHNODACTYLY

A CASE REPORT

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CHARACTERISTICS

The average horizontal diameter of the cornea is 11.6 mm., while the vertical diameter measures 10.6 mm.[1] In all cases of anterior megalophthalmos the corneal diameters are enlarged and may even reach 18 mm.; but in addition to the enlarged corneal diameters, there are other signs, according to Vail,[2] such as: 1. It is hereditary. 2. Always bilateral and limited to the male sex, except in cases of consanguinity. 3. Absence of all signs of glaucoma. 4. Deepening of the anterior chamber. 5. Iridodonesis. 6. Atrophy of the stroma of the iris. 7. Embryotoxin. 8. Dislocated or tremulous lens. 9. Sometimes a melanosis of the cornea. 10. Unusually visible nerve fibers in the cornea. 11. Sharply defined corneoscleral margin.

CASE REPORT

D. D., a white female, aged five months, was seen on the Ophthalmic Service at Cincinnati General Hospital on October 27, 1941. Diagnosis of arachnodactyly had been made at birth, and the patient had been recently readmitted to the hospital for reduction of intussusception. Recovery was uneventful. Until the present admission the patient had never been ill.

Inspection of the eyes revealed a striking enlargement of the cornea, measuring 15 mm. in the horizontal and 14.5 mm. in the vertical diameters. The cornea was transparent, and the limbus sharply demarcated. There was no evidence of embryotoxin. A marked corectopia of the pupils was present, the right pupil appearing displaced nasally and downward. The upper half of the pupils was oval whereas the lower half terminated in an acute angle, much as in the letter V. They measured 2 mm. in the horizontal diameter and 3 mm. in the vertical diameter, and reacted well to light and accommodation. The anterior chamber was very shallow and the irides a pale blue. Examined with a plus 20 lens, the superficial stroma of the iris was seen to be atrophic, with a complete absence of the normal crypts, while the radiating arrangement of the iris fibers was very conspicuous. There was no iridodonesis. The lens was in normal position, the media were clear, and the fundus was seen distinctly with a plus 4 lens. The disc of the right eye was elliptical in shape in the 80° axis, while the left disc was elliptical and in the 110° axis. The choroidal vessels were very apparent, giving the fundus a tessellated appearance.

Slitlamp examination and tonometric measurements could not be made; however, the tactile tension was normal. Transillumination did not reveal the "target reflex" described by Vail.

Physical examination disclosed a thin, white, female baby possessing fine blond hair and a dolichocephalic skull. The chest was somewhat funnel-shaped, but the remarkable finding was the abnormal thinness and length of the long bones of the body (dolichostenomelia), especially of the hands and feet, the latter having the appearance of the limbs of a spider, hence the name arachnodactyly. There was a muscular wasting of the arms, forearms, hands, thighs, legs, and feet. The abdominal muscles did not share this process. There was no kyphosis. There

was a marked flexion deformity of the fingers resembling a "claw hand." The ligaments about the joints of the shoulder, elbow, wrist, hips, knees, and ankles were especially lax. The legs could be bent flat on the back and crossed with no semblance of pain. The external malleoli of the tibia were very prominent. There was no clubbing of the fingers, and nails were normal. However, there was a tiny supernumerary digit on the ulnar side of the hand.

The skull was symmetrical in shape, palate and teeth were normal, and no abnormality of the ears was noted. The lungs and heart were normal as also the abdominal viscera (noted at operation). Neurologic examination was negative.

Radiograms of the hands and feet revealed a marked increase in length out of all proportion to the body height. However, there was no abnormality in the bone structure *per se*. The sella turcica and clinoid processes were normal for this age.

The thyroid and other endocrine glands were apparently normal.

Gross and microscopic examination of the urine was entirely negative and the blood count was normal. The Wassermann test was negative.

Inasmuch as this disease has a familial tendency, an inquiry was made into family history, especially as pertaining to the eyes. The grandparents, as far as could be ascertained, had normal eyes. The parents were not related. Five other children exhibited normal corneas, although the diameters were slightly larger than normal.

Theories regarding etiology

The hereditary and etiologic aspects of this disease have been discussed in great detail by many other authors. I merely wish to stress the theory of gene exchange by Rados[3] as being more satisfactory in the explanation of the variations found in megalophthalmos. The present paper shortage precludes a discussion of his theory, but with it in mind, one easily sees how conditions such as anterior megalophthalmos can exhibit a megalocornea and atrophy of the iris, or megalocornea and a shallow anterior chamber, or megalocornea and ectopia of the lens, or that there may be megalocornea alone. Any of the aforenamed combinations are possible according to the disturbance in the original gene. The major characteristics enumerated by Vail are not necessary for a diagnosis of megalophthalmos.

Anterior megalophthalmos may be associated with a long, slender body structure as in the case herein described, or with embryologic defects in the skin about the orbit, as in a recent case not published, or associated with polydactyly, syndactyly, and other abnormalities.

There are then many variations to be expected in an anomaly such as anterior megalophthalmos. In my case the anterior chamber was shallow instead of deep, the lenses were not ectopic, and of course there was no iridodonesis, although all of these signs could develop in later life. A better term to describe these variations might then be suggested such as anterior dysophthalmos. Anterior megalophthalmos, megalocornea, persistent pupillary membrane, ectopia lentis (usually transmitted as a dominant characteristic), microphakia, microcornea, and anterior microphthalmos (colobomata* of the iris often seen) could then be classified as variations of anterior dysophthalmos.

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* If the mechanical hindrance to the development of the iris is operative at an early stage before the iris has begun to grow forward, a coloboma results; but if it becomes operative after the iris is already partly formed, an ectopia is produced (Duke-Elder, v. 2, p. 1318).

SUMMARY

A case of arachnodactyly associated with anterior megalophthalmos has been presented. Emphasis has been given to the genetic aspects of the disease. It has also been shown that there are many variations of anterior megalophthalmos, which is to be expected, owing to the infinite number of variations of minute disturbances in the genes. Finally, a term has been suggested, anterior dysophthalmos, which, while not conveying the thought of an enlargement of the anterior segment, does cover all the variations found in this disease as well as others of a related nature.

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SUCTION INSTRUMENT FOR CATARACT EXTRACTION*

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For the removal of cataracts by means of suction, this instrument was devised to provide the following advantages: It is easy to manipulate; the suction power is adequate; and the suction is self-controlled in being automatically cut off when the cap is removed from the lens.

The Dimitry syringe was used to produce the suction, but it was found that the suction power of this instrument could be increased to great advantage.

This instrument displaced a 5-mm. column of water 45 mm. in height, a value increased to 65 mm. by shortening the stem of the piston.

A 6-inch length of firm rubber tubing connects the syringe to the handle by means of adaptors.

The handle having the suction needle is easy to manipulate and was made to correspond in curvature to the Kirby intracapsular-lens forceps.

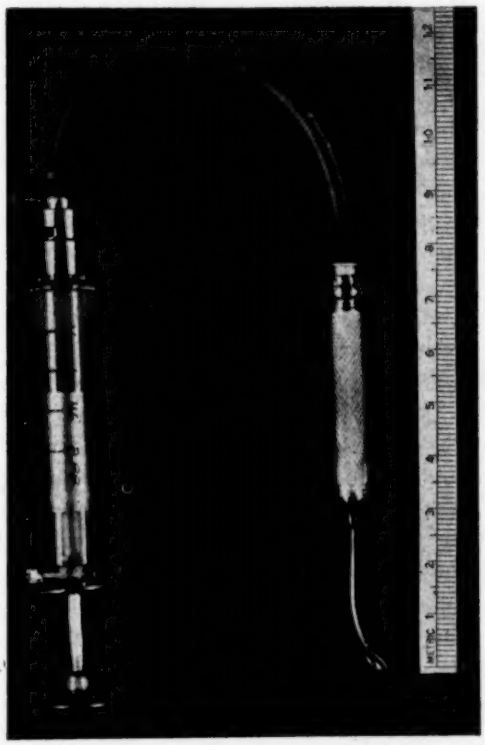

Fig. 1 (Thomas). Suction instrument for cataract extraction.

In using the instrument the assistant holds the syringe and the suction is applied as directed by the operator.

* From the Department of Surgery, Division of Ophthalmology, Western Reserve University, Medical School.

RETINOSCOPY AT A VARYING DISTANCE

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Speed is a desideratum in the preliminary phase of a refraction. The frequent changing of lenses in a trial frame before a patient's eyes during retinoscopy is wearisome and time-consuming. At the conventional distance of one meter the examiner must rise repeatedly from his seat in order to reach the trial frame and change the lens. The use of a vertical bar or frame of spherical lenses is scarcely less troublesome. The patient must be instructed how to hold and move it properly; furthermore, any tilting of the bar will introduce a false astigmatic factor.

The procedure to be described* should eliminate some of the usual changing of lenses. It also should enable the examiner to ascertain rapidly whether or not astigmatism is present, and if so, the approximate amount.

The examiner sits at a distance of about three quarters of a meter from the patient, and, flashing his retinoscope, moves toward the patient and watches for a point of reversal. If the reversal involves all meridians a spherical error, of course, is present, and no appreciable amount of astigmatism should exist. If the reversal occurs in only one meridian, the distance from the patient's eye is measured quickly along a marked tape that is stretched from the patient's eye to the retinoscope. The examiner then moves in still closer until the opposite meridian shows a point of reversal. Again, this distance is measured on the tape. The dioptric value of the difference between the two distances indicates the amount of astigmatism. Following is a detailed explanation and description.

The examiner sits at a distance of 75 cm. from the patient. If the eye is hypermetropic and astigmatic a sufficiently strong convex spherical lens is placed in the trial frame before it to bring the first point of reversal (the far point of the first of the two principal meridians that have been made artificially myopic by the convex sphere) to a distance of a little less than 75 cm. from the patient's eye. Usually one or two lens changes will be sufficient to find the right strength for converting the "with" movement of the image of the illuminated retinal area to an "against" movement. If the eye is myopic and astigmatic a sufficiently strong concave sphere is placed before it in order to advance the image of the illuminated retinal spot to a point that is a little less than 75 cm. from the patient's eye. Once the proper lens is in front of the eye the examiner moves in along the marked tape (to be described in the next paragraph), flashing his retinoscope alternately in the horizontal and vertical meridians until a point of reversal is seen in one of the meridians (until the "against" movement of the image changes to a "with" movement). At this point the position of the retinoscope along the tape (the distance from the patient's eye) is noted. The examiner then continues to approach the patient until a reversal occurs in the opposite meridian. Again the position of the retinoscope along the tape is noted. Then, moving slowly backward, the examiner checks his findings by once more observing the positions of the two points of reversal. This time the change will be from a "with" to an "against" movement. Once the proper spherical lens is in place the examiner can perform this whole measurement without leaving his seat by simply bending from the hips first forward slowly and then backward. The difference in the dioptric values of the two distances on the tape indicates the amount of astigmatism that is present.

* Very likely this procedure is not original. The author, however, is not aware of its use by anyone else.

Ordinary narrow cotton or linen tape may be used. A mark is made near one end. The patient holds the tape against the side of his face so that the mark is in line with the front of his cornea. Various convenient distances are marked off on the tape starting from the mark. The dioptric values of these distances are printed over each mark. The following values represent a suggested series of distances and their designations: at 15.4 cm., 6.5D.; at 16.7 cm., 6D.; at 18.2 cm., 5.5D.; at 20 cm., 5D.; at 22.2 cm., 4.5D.; at 25 cm., 4D.; at 28.6 cm., 3.5D.; at 33.3 cm., 3D.; at 40 cm., 2.5D.; at 50 cm., 2D.; at 66.6 cm., 1.5D.; and at 75 cm., 1.3D. If the examiner holds the retinoscope with the right hand he loosely takes hold of the tape near its middle with his left hand. As soon as a point of reversal is noticed the tape quickly is stretched taut as far as the retinoscope, and mental note is made of the dioptric value of that distance.

The author has found this procedure to be useful in some cases. Its basis is a change of distance rather than the convential change of lenses. No procedure is universally applicable, and a stereotyped method of refraction cannot be used satisfactorily in all cases.

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EYE FINDINGS IN RHEUMATIC FEVER*

CARL J. RUDOLPH, MAJOR (MC), A.U.S.

In recent years there has been a marked trend to delete rheumatic fever as the basis for eye involvements such as iritis, iridocyclitis, uveitis, choroiditis, episcleritis, scleritis, and the like.

The Quarterly Cumulative Index Medicus shows a marked diminution of articles describing eye lesions as a complication of rheumatic fever. The Index Catalogue of the Library of the Surgeon General's Office shows a similar trend:

1st series—1880-1895 reference was made to 13 books and 53 periodicals.

2d series—1896-1916, one book and 39 periodicals.

3d series—1917-1932, one periodical.

4th series—1936-1942, no listing of books nor periodicals.

The reason for this trend is undoubtedly due to the more scientific investigation of a patient and improvements in our laboratory technique. Previously, ocular pathology in which difficulty was experienced in determining its cause was relegated to the category of rheumatic fever. Frequently this would provide a "catch all" for syphilis, tuberculosis, gonorrhea, and other diseases that may provide the basis for a joint involvement and the true diagnosis would have eluded the examiner.

This is well illustrated by Fuchs[1] in describing paralysis of the orbicularis muscle. "These are rheumatic paralyses for the most part of which, however, the real cause is not known." Elsewhere in the same volume by Fuchs several eye conditions are described as being due to rheumatism. To mention two of the more vague references: page 197, rheumatism as etiology for scleritis and sclerosing keratitis; page 222, episcleritis rheumatica.

The existence of a doubt as to etiology is well exemplified by Knies[2] in 1895. "An acute articular rheumatism must be regarded as an infectious disease, although a typical agent of inflammation has not been discovered."

E. V. L. Brown,[3] in 1937, calls attention to the fact that rheumatic iritis is not specific.

In 1915, A. E. Davis[4] stated: "Some of the affections of the eye which have a rheumatic origin are: Iritis, cyclitis, epis-

*This article concerns itself primarily with acute rheumatic fever and not with the chronic arthritides, since these are, in most instances, of an undetermined etiology.

cleritis, scleritis, keratitis, sclero-keratitis, inflammation of Tenon's capsule, muscular paralyses and optic neuritis and even glaucoma have been attributed to it." This gives a concrete example of the numerous disease entities formerly ascribed to rheumatic fever.

The uncertainties of treatment and diagnosis are reflected in the two following quotations; Emil Erroth,[5] 1932, advises "a change of climate to be of benefit in cases of rheumatic iritis."

F. E. Noboa-Recio,[6] 1941, suggests X-ray examination of joints to establish the identity or type of joint involvement and also the use of the sedimentation test.

The present trend to minimize rheumatic fever as the cause of ocular disease is the more plausible because the eye complications are thought of as a part of the picture of syphilis, tuberculosis, gonorrhea, and the like, and are classified under that heading, hence the scarcity of literature of recent date captioned rheumatic fever as an etiologic basis for various and sundry eye involvements.

A careful study of the eyes in 105 cases of rheumatic fever at Buckley Field has resulted in essentially no eye findings. This is emphasized by the fact that approximately 200 additional rheumatic-fever cases have been confined to this hospital during the same interval of time—September, 1943, to March, 1944, inclusive—without unusual subjective or objective eye symptomatology. Two additional Army hospitals in this area, Lowry Station Hospital and Fitzsimons General Hospital, likewise report negative findings; the first in 300 cases of rheumatic fever and the second in 50 cases.

The most recent work at this time credits the group-A hemolytic streptococcus as probably being the exciting factor in rheumatic fever. One hundred five cases were selected at random and were carefully examined as to vision, anterior segment, media, and fundi. The pupil was dilated in all cases to allow access to the extreme periphery of fundus.

The cases were classified under three headings: (1) severity (mild, moderate, severe); (2) stage (early, mid, terminal); (3) eye findings.

Severity:		Stage:	
Mild	12	Early	18
Moderate	40	Mid	40
Severe	53	Terminal	47

These figures would indicate a fairly good cross section of cases. We were anxious to obtain this so that if any ocular pathologic changes were manifested as a transient involvement they should have been discovered in some of the cases examined.

The eye findings were as follows:

(1) Eyes normal throughout, 94;
(2) Injection of deep conjunctival vessels, 9;
(3) Blood in veins dark, 2;
(4) Vision in no case was impaired as a result of rheumatic fever.

An analogy between joint involvement and teno-synovitis was considered. A purpling of the deeper conjunctival vessels was found in nine cases; however, the classical symptoms of a teno-synovitis were nonexistent.

Fields: Fields were taken in 20 cases of recurrent rheumatic fever, for it is our impression that these cases would be the more likely to show a field defect provided there was at any time during the course of the disease an involvement of the optic pathway. No field defect was found. An isopter of 2/1,000 was employed.

These results were in marked contrast to the finding of Pillat as quoted by Lowenstein[7] "Foci similar to the foci in miliary tuberculosis can be found in 61% of the cases of acute rheumatic fever by ophthalmoscopy."

An interesting observation made in regard to the patients who received massive doses of salicylates was that approximately 50 percent of them observed visual phenomena described as lights passing across their field of vision. This was noted to a lesser degree in those receiving penicillin. The phenomena was also markedly reduced in the controls who received soda bicarbonate and/or bed rest. The intensity of light was described by different individuals as varying in intensity from silver spots to the appearance of a roman candle.

In approximately 20 percent of the cases there was evidence of increased rapidity of the fatigue time of accommodation. This was noticed mostly in those who were hyperopic to a moderate degree and who were not conscious of asthenopia before contracting rheumatic fever. Chief complaint was "tiring of the eyes" after reading for a short time. Frequently a general debilitating illness will result in this finding.

In conclusion, it is our impression that the group-A hemolytic streptococcus, presumably causing rheumatic fever, may involve the eyes. However, we are convinced that rheumatic fever has in the past been accredited as the etiologic basis for eye conditions for which it was not responsible. This confusion is easily understood, as the rheumatic involvement with hemolytic streptococcus is far different from the ordinary reaction to this organism, the former being on an allergic basis.

In a careful study of 105 cases of rheumatic fever which was taken as a typical cross section of 650 cases in all, together with a review of literature, we are convinced that there is no ocular pathologic change pathognomonic of rheumatic fever.

"Penicillin and the sulfa preparations have to date had no definite therapeutic value in the treatment of rheumatic fever,"[8] therefore it should not be of benefit in treating an ocular complication of rheumatic fever.

Grams[9] and I concur with Lowenstein[7] in the impression that rheumatic fever is an allergic manifestation pathologically characterized by fibrinoid necrosis of collagenous ground substances followed by a cellular response known as the Aschoff body.

The credit for the last two conclusions should be given to the departments, mentioned in references, which are also engaged in research work on rheumatic fever under the auspices of Major General David N. W. Grant, Surgeon for the Army Air Forces, and his staff.

202d General Hospital Unit.

Since the time this paper was written, I have examined approximately 45 more cases of rheumatic fever. Three patients had transient scotomas, which entirely disappeared within 30 to 90 minutes. One of these was due to an angiospasm of a branch of the central retinal artery; the other two to angiospasm of an artery in the occipital cortex.

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SOCIETY PROCEEDINGS

EDITED BY DONALD J. LYLE

ROYAL SOCIETY OF MEDICINE

SECTION OF OPHTHALMOLOGY

November 12, 1943

MR. FRANK A. JULER, *president*

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INTRAOCULAR FOREIGN BODY

MR. J. W. E. CORY presented an engineer, aged 37 years, who was seen on October 12, 1943. He gave a history of having got something in his right eye three days previously.

A large metallic foreign body was seen lying in, or just posterior to, the posterior capsule of the lens. There was a small entrance wound at the 2-o'clock position, 2 mm. from the limbus, but there was no visible injury to the iris.

The vision was R.E. 6/60 (previous to accident 6/36 improved to 6/9) and L.E. 6/6. The fragment, which was part of a brass cotter pin, showed indistinctly in the X-ray picture and was nonmagnetic.

There seemed to be very little reaction after five weeks and it was deemed advisable not to operate unless a cataract developed.

FLOCCULI

MR. R. A. D. CRAWFORD presented a soldier, aged 25 years, who had had no previous trouble with his vision until he complained of blurring of the vision of the left eye in strong sunlight. He had flocculi of both irides, larger in the left eye than in the right, and in the left eye there had formed an anterior attachment to the back of the cornea. No reference to this condition, last named, could be found in the literature. The condition apparently resulted from a failure of closing and cystic dilatations of the marginal sinus.

Discussion. Mr. F. A. Juler said that he had never seen an attachment to the cornea of this kind. The common "grape-seed bodies" protruded into the pupil, but he had not seen them hanging in the anterior chamber.

Mr. A Greeves said that it seemed likely to him that the mass was not actually attached to, but merely in contact with, the posterior corneal surface against which it was flattened on account of its bulk.

EPIBULBAR DERMOID WITH RUPTURE OF CYST CONTENTS INTO ANTERIOR CHAMBER

DR. VICTOR PURVIS reported the case of a child, aged one year and four months, who was brought to Moorfields Hospital one year ago with a history of a swelling on the right eye since birth. Recently a sudden increase in the size of the swelling had been evident.

On examination it had all the appearances of an epibulbar dermoid, but there was an amount of white flocculent material in close proximity to it in the anterior chamber. It was considered that this material was the contents of a ruptured dermoid cyst. During the next few months the eye became irritated from time to time and the flocculent material became absorbed, drawing down the pupil in the process.

Two months ago another mass of material suddenly appeared in the anterior chamber near to the cyst, as if the latter had ruptured once more. It was proposed to wash out the anterior chamber to ascertain the nature of the material and enable a correct diagnosis to be made. If the tumor proves to be a dermoid it is unique, for these are rarely cystic at this site and are not known to rupture into

the anterior chamber in the way described. On the other hand it might have been an implantation cyst in spite of the fact that there was no history of injury.

THE INCIDENCE AND TREATMENT OF OPHTHALMIA NEONATORUM

PROF. ARNOLD SORSBY said that ophthalmia neonatorum has been a notifiable disease in England and Wales since 1914, and has shown some decline in incidence. There is, however, considerable variation in the rate of notification in different parts of the country, pointing to different conceptions as to what constitutes notifiable ophthalmia neonatorum. Replies to a questionnaire sent to lying-in centers indicate a rate of gonococcal ophthalmia of 0.8 per 1,000 births. On this basis there are annually about 500 cases of this type of ophthalmia neonatorum and a total of about 2,000 cases of all types throughout the country.

The annual returns of the Ministry of Health indicate a steady decline in the incidence of impaired vision and blindness from ophthalmia neonatorum.

Antenatal care is of prime importance, as is shown by excellent results in eliminating ophthalmia neonatorum at such centers as Sheffield Street Hospital for mothers suffering from venereal disease. Prophylactic drops instilled into the eyes of babies at birth are no absolute safeguard against gonococcal ophthalmia, as the occurrence of 98 cases in 119,075 births given in the returns of the questionnaire show. On the basis of these returns the incidence of gonococcal ophthalmia is 0.9 per 1,000 births when silver nitrate is used as a prophylactic, and 0.7 per 1,000 births when other preparations are used (generally argyrol).

The immense advance marked by the sulfonamides in the treatment of ophthalmia neonatorum of all types is shown by the fact that in 500 cases treated at White Oak Hospital during January, 1940, to October, 1943, no less than 72.2 percent cures were effected within eight days (against 15.2 percent of cases treated by the classical method).

Discussion. Dr. Letitia Fairfield said with regard to the quesiton of notification, that London was the pioneer in collecting cases of ophthalmia neonatorum into a specialized hospital (Saint Margaret's now evacuated to White Oak). The London notification rate was only about 9 per 1,000 as against the 60 per 1,000 of Birmingham, but the results were very similar.

She said that the prophylaxis used for infants in the London County Council wards was very much like that described by Professor Sorbsy, and the variety of drugs employed seemed to matter little. The figures showed that antenatal care seemed the main preventive factor, but a cerain number of cases did slip through in spite of very careful antenatal work.

Prof. Chassar Moir said that a slight inflammation of the eyes was very common in the first week of life. Cases of "sticky eye" were often not notified, and discrepancies in statistics could be largely explained by this fact. As prophylaxis against gonococcal ophthalmia, silver nitrate has stood the test of time, but it was also true that silver-nitrate solution was irritating and frequently produced a chemical conjunctivitis of its own. His belief was strengthened by the fact that after the use of a 2-percent solution of silver nitrate instead of the usual 1-percent, cases of inflammation were much commoner and more severe. The possibility of serious harm resulting from the reckless repeated use of silver nitrate, the other name of which is lunar caustic, should be realized. Better methods of treatment were now available.

Mr. Frederick Ridley said that his experience had also been that the use of silver nitrate did undoubtedly lead to a large incidence of "sticky eyes." The

treatment of such eyes by silver-nitrate drops was definitely harmful. He believed it was dangerous to use even a 1-percent solution of silver nitrate upon a baby's cornea which was already ulcerating, and he thought it should be barred. The acidity of a 1-percent solution of silver nitrate kept in a tightly stoppered bottle had reached the value of pH2. The concentration also continually increased by evaporation, and he had seen silver-nitrate crystals formed in a dropper bottle; such drops were capable of blinding a baby.

Argyrol was a safe and even more effective prophylactic than silver nitrate. It did not change spontaneously on keeping; even if it became concentrated by evaporation, it did not become harmful. He would strongly advocate that argyrol be used in the place of silver nitrate as a routine prophylactic.

Professor Sorsby, in closing, said it was futile to rely upon one solitary measure for the elimination of ophthalmia neonatorum. In the whole range of public health there was no procedure which would rely on one drop of an antiseptic to prevent the development of infection in people who had been exposed to it. Antenatal care was extraordinarily important as the figures had shown.

In very many institutions silver nitrate was used as a standard method. It had been used in millions of births so that it could not be so desperately dangerous as some people believed. That did not mean, however, that there were no better drugs. The figures obtained from lying-in hospitals possibly showed argyrol to be superior to silver nitrate, but the series was too small from which to judge.

Rupture of retinal cyst causing retinal detachment

Major C. Dee Shapland (RAMC) presented J. S., a soldier, aged 28 years, who was sent to the hospital on September 20, 1943, because of failing vision in the right eye, noticed for the previous six weeks. On August 2, 1943, the day before he noticed that the vision in the right eye was misty, he had felt a sudden sharp shooting pain lasting about two or three minutes in the region of the right temple, and felt giddy and faint.

On examination, on September 20th, the right eye was white and there were no keratitic precipitates. The pupil was active and the tension was normal. A flat detachment of the retina was present temporally, extending from the 6:30- to the 11-o'clock position. From the 7- to the 9- o'clock position there was a prominent thin-walled retinal cyst, with ragged dialysis from 7:30- to the 9-o'clock position. The interesting feature was a linear band of retinochoroidal pigmentary disturbance delimiting the periphery of the cyst above and below. This disturbance was the type usually seen at the high-water mark of static detachments of long standing. Therefore the cyst was old.

It had evidently ruptured at its peripheral attachment at or just behind the ora serrata, and the delimiting band of choroidoretinal adhesions had given way over the nasal part of the cyst and caused a spreading detachment of the retina over the temporal half of the fundus. The macula was involved in the detachment, and central vision was reduced to 3/60. The visual field was contracted nasally.

Operation was performed on September 24, 1943. The external rectus was detached and a barrage of surface diathermy applications was placed around the periphery of the scleral-surface marking of the cyst. One needle puncture was made over the center of the cyst and another at the 6:30-o'clock position, 12 mm. from the limbus. The patient was kept in bed in the Fowler position with both eyes padded for two weeks and was allowed up for an hour on the fifteenth

day. The retinal detachment went back and the cyst was smaller and outlined by a zone of diathermy reactions. The contraction of the diathermy punctures had pulled down the wall of the cyst and caused it to shrink. The dialysis was still clearly visible and open. The retina was in place. The central vision was 6/24, partly. The visual field was full except for a defect on the nasal side corresponding to the cyst and diathermy reactions.

This case was interesting in that a retinal dialysis, as had long been suspected, could definitely be produced by the rupture of a cyst and that little or no trauma caused its rupture. In this patient the periphery of the cyst tended to be sealed off by a zone of spontaneously formed retinochoroidal adhesions, and a portion of these gave way on the formation of the dialysis and so caused a spreading detachment of the retina.

Discussion. Mr. C. B. Goulden said that the connection between retinal cyst and disinsertion had long been suspected, and some suggestive findings by Weve of Utrecht gave support to this possibility. He had found that the retroretinal fluid removed in cases of disinsertion had similar enzymes to those found in the fluid from a retinal cyst. He believed that in cases of retinal cyst operation should be undertaken before they gave rise to disinsertion, as they were much more easily managed.

Dr. T. H. Whittington said that he recalled several cases of retinal cysts. One was in a man who came for a detached retina due to a disinsertion, and in making the routine examination of his eyes an unruptured peripheral cyst was found at exactly the corresponding spot in the other eye. The second patient was a nurse who had a disinsertion which looked just like a ruptured cyst, and there was an unruptured cyst of similar appearance close by. Both cases were successfully treated.

COLORADO OPHTHALMOLOGICAL SOCIETY

November 20, 1943

Dr. C. A. Ringle, *president*

Carcinoma of the choroid

Dr. F. Nelson presented the case of Mrs. B. G., a white woman aged 65 years, who was first seen September 8, 1943. She complained that two days previously a brown cloud had appeared before her left eye in the lower part of the visual field.

The fundus of the left eye showed a very flat disclike elevation about 10 disc diameters wide, and of not quite that height, located above the macular region. The elevated area slanted very gradually to the normal level of the retina. The elevation at the highest spot was about 6 diopters, corresponding to about 1.5 mm. The color of the detached area was slightly yellowish-pink. Both eyes had a refractive error of about 5 diopters. The corrected vision was R.E. 5/5, L.E. 5/8 partially. The visual field of the left eye showed a relative scotoma corresponding to the detached area.

The history was somewhat difficult to establish, since the patient was a Christian Scientist and was reluctant to reveal exact data of previous illnesses. The right breast had been removed in August, 1938, but the patient had noticed a lump in that breast since 1935 or 1936. She had refused surgery at that time. She complained of loss of weight and showed signs of vitamin-B deficiency. There was irregular pigmentation on the dorsum of both hands and the tongue showed changes which were characteristic of pellagra.

The patient was admitted to Glockner Hospital, and a diagnosis of detachment of the retina of the left eye due to possible metastatic malignancy in the choroid

was made. During the period of observation the detached area seemed to flatten and the positive scotoma became less noticeable. The patient became more and more dyspneic and cyanotic. An X-ray picture of the chest showed thick shadows over the whole left lung field, indicating invasion of the tumor into that lung. During the last week of her life she became more disoriented and had hallucinations. The patient died on October 11, 1943.

Autopsy showed generalized carcinomatosis. The brain was free of metastases but showed a number of minute cortical hemorrhages. The left lung was almost totally involved in tumor masses invading numerous bronchi. The right lung was affected to a minor degree. The primary tumor of the right breast had not invaded the chest wall. A number of coin-shaped cancerous lesions were found in the liver, particularly on the convexity and in the lobus quadratus. The heart was not enlarged but showed a number of flat tumor masses in front of the conus arteriosus. The tumor had invaded the heart muscle deep into the interventricular septum. A very advanced sclerosis of the coronary arteries apparently had prevented the tumor from invading the arteries themselves, so that in this case the sclerosis had given the heart a certain amount of protection. The left eye was enucleated, *post mortem,* and showed a flat carcinoma of the choroid above the posterior pole in about the same extension as the ophthalmoscope had revealed. Cross sections through the stump of the optic nerve showed a tiny strand of accumulated tumor cells in the outer layer of the nerve sheath, probably located in a small lymph vessel. It is possible that the metastases in the choroid spread from this strand.

Conclusions. A breast carcinoma was removed probably three years after the beginning of the primary tumor. Extensive metastases occurred five years after the first operation and about eight years after the beginning of the primary tumor. The first subjective and objective manifestation of generalized carcinomatosis was in the choroid.

Malignant melanoma of the right choroid

Dr. F. Nelson presented the case of Mrs. A. A. F., aged 54 years, who was first seen on August 22, 1938. She complained of continuous flashes in the right eye which had been present for about 18 months. A diagnosis of focal infection had been made.

The eyes were externally normal. The corrected vision was R.E. 5/5, partially; L.E. 5/4. A large detachment of the retina was found in the nasal section of the right eye. The detachment was hemispherical in shape and showed no fluctuation nor folds. The color of the detachment was slate-gray with some darker spots shining through the retina. Transillumination revealed complete darkness in the detached area, indicating a tumor formation behind the detachment. The intraocular pressure was 18 mm. Hg (Schiøtz) in both eyes. The visual field showed a large peripheral scotoma corresponding to the detached retinal area. A diagnosis of malignant melanoma of the choroid of the right eye was made. Enucleation was advised and performed the next day.

Histologic examination revealed a malignant melanoma of the choroid mushrooming into the intraocular space at the nasal side of the globe. In some sections wandering of tumor masses along one posterior ciliary nerve was observed. This perforation could not be seen macroscopically. Pigment cells were more abundant in the intrascleral tumor.

The patient was seen once a year, the

last time on October 13, 1942. At that time no local recurrence was found and there was no evidence of metastasis to any other part of the body. The patient was warned to watch for liver or gall-bladder trouble. During the summer of 1943 the patient developed some abdominal distress and reported loss of weight. A surgeon detected an enlargement of the liver and did an exploratory laparotomy on July 19, 1943, and found definite malignancy of the liver. The patient died on October 8, 1943.

Metastasis to the liver is more frequent in cases of malignant melanomata of the uveal tract. In this case almost seven years elapsed between the first ocular symptoms and the patient's death. Abdominal operations in such cases are usually unnecessary and contraindicated. Specimens of the tumor were shown microscopically.

Bilateral ocular injury

Dr. V. H. Brobeck presented the case of M.G., aged 14 years, who was injured by the explosion of a dynamite cap on June 19, 1940. When he was first seen, one hour following the injury, the distal phalanx of the thumb, middle finger, and ring finger of the right hand were destroyed. The upper two-thirds of his face was the site of countless small perforating abrasions and punctured lesions of the skin and eyelids.

The anterior chamber of the right eye showed considerable hyphemia. Two small lesions, one on the cornea and one on the episcleral region below the level of the insertion of the right internal rectus muscle, were quite probably locations of the perforating foreign bodies. After clearing occurred in this eye, a fairly large glistening foreign body was observed in the lower nasal anterior segment. Beneath it was a large area of chorioretinitic damage.

In the left eye, the lens soon became cataractous following its perforation by a metallic fragment. After a period of six weeks the synechiae in this eye were freed by a keratome incision at the 3-o'clock position, the lens was "puddled" and the anterior chamber irrigated with saline. This resulted in the recovery of a brass foreign body, 0.5 by 1 mm. in size.

Two years after the injury, the right eye, still containing the copper in the vitreous, was quiet, and the vision was 0.8. It had never showed signs of irritation since the first inflammatory reaction subsided, but the vision finally was reduced to light perception.

The vision of the aphakic left eye was 0.5 with +16.00D. sph. ⊂⊃ −4.50D. cyl. ax. 135°; +3.00D. sph. added for near vision.

Many consultants in the Middle West agreed to leave the right eye unmolested under a régime of frequent inspection. The left eye had just recovered from an attack of iridocyclitis.

Questionable detachment of the retina

Dr. E. N. Neeper presented Mrs. A. C., who was first seen in August, 1927, at which time she was 26 years old and a patient in a tuberculosis sanatorium. Headaches and blurring of vision were relieved by correction of refractive error. Ophthalmoscopic examination showed a small inflamed area just below and slightly to the temporal side of the disc in the right eye, and an old pigmented area, 1.5 mm. in size, below the disc in the left eye. The area was surrounded by moderate hyperemia.

At various times during the following five years choroidal tubercles in different stages were seen in both eyes, each such area finally healing with only slight or no perceptible damage. Old tuberculin, in his opinion, proved to be the treatment of

choice. A period of 10 years elapsed without any complaints referable to the eyes or general health. Since November 12, 1943, however, the patient had complained of floating opacities and flashes of light, day or night, on quick head movements. The vision, L.E., was 20/15−2. Examination of the visual field showed a moderate scotoma above and to the temporal side. Copper-tinted linear opacities were present in the vitreous. No detachment folds nor prominences could be seen. There was, however, slight pallor below the disc and macula. Visual field, taken on November 18th, revealed a 20-degree, deep, irregular, crescent-shaped blind area 15 degrees below the macula.

This case was presented as a probable simple, flat, retinal detachment. The diagnosis was based largely on the presence of the blind area and the photopsia. The absence of any central scotoma, headache, and pain in the orbit on eye movement or pressure ruled out retrobulbar neuritis.

Discussion. Dr. George Stine suggested as a possible diagnosis a low-grade uveitis, but thought that the case required further study.

Herpes zoster ophthalmicus

Dr. E. N. Neeper presented Mr. J. A., aged 65 years. He gave a history of severe influenza in January, 1943, which left him in poor health. In March, 1943, he complained of much pain in and above the left eye. A diagnosis of neuralgia was made by his physician. The use of hot compresses was instituted, but it was thought that the hot packs scalded the skin and that a skin infection followed on the forehead. During the four months that followed he suffered much pain. The patient was seen for the first time by Dr. Neeper on July 13th, when the diagnosis was obviously herpes. Posterior synechia was present. The ciliary ring was greatly injected. The cornea stained throughout. The vision, L.E., was ability to see light.

When last seen only one narrow tongue of the synechia remained. Occasional corneal staining occurred. There was intermittent slight ciliary injection, and while the patient was conscious of all of the involved area most of the time, paroxysms were gradually becoming less frequent. The vision at this time was 20/120 owing to the lens and corneal haziness. As the toxins are gradually eliminated it is hoped that useful vision will be restored.

Medication consisted of atropine, paradrine, phemerol, sulphonamides, and dionin.

Discussion. Dr. J. W. Lamme reported good results in the treatment of this disease from the use of sodium iodide, snake venom, and viosterol.

W. A. Ohmart,
Secretary.

SAINT LOUIS OPHTHALMIC SOCIETY

November 26, 1943

Dr. Carl Beisbarth, *president*

The use of doryl in glaucoma

Dr. J. F. Hardesty presented a paper on this subject which has been published in this Journal (1944, v. 27, June, p. 625).

Discussion. Dr. John Green said that his experiences with doryl coincided closely with those of Dr. Hardesty. He told of a complicated case which he had seen with Dr. Carl Beisbarth at the Saint Louis County Hospital. The patient had absolute glaucoma in one eye and was having an acute attack of glaucoma in the other eye. At the time of admission to the Hospital the vision was reduced to perception of hand movements and shortly thereafter to ability to see light. An iridectomy was done on the better

eye with beneficial effect that lasted about one month. Following that a corneoscleral trephining operation was performed by Dr. Beisbarth, using a 3-mm. trephine. After this operation a normal tension was maintained for at least a year, following which the patient developed a uveitis, with recurrence of the increased tension. After treatment at De Paul Hospital with suprarenin bitartrate locally, general medication, and the removal of several infected teeth, the tension was reduced but did not return to normal. Several months later two cyclodiathermy operations were performed, resulting in a moderate reduction of tension and the maintenance of vision of 20/60. Pilocarpine and eserine apparently had no effect on the tension. Doryl was finally used and caused a marked lowering of the tension within a short period of time. A tension of 40 mm. Hg (Schiøtz) could be reduced to 20 mm. Hg in an hour after instillation. There was no appreciable effect on the pupil.

Dr. William H. Luedde reëmphasized some of the things Dr. Hardesty had discussed. He said that doryl does seem to offer some real advantages. In his experience he had had the greatest satisfaction from the use of doryl in cases of postcataract glaucoma, in which cases it usually seemed dependable. He had had some patients who were sensitive to doryl and who exhibited marked sweating and discomfort following its use.

Major James Allen (MC), by invitation, said that in the past 18 months his experience with glaucoma had been limited to two cases, for glaucoma is not encountered very often in the Army. He said that doryl has been used for a number of years and it has been found to be somewhat unreliable. It is not readily absorbed through the cornea. It may be, however, that if something could be done to the cornea to increase the penetration of doryl through it, the effect might be better. In the early experimental work on rabbits Oppenheim abraided the cornea and got uniform action. He began to use a solution of 1:3,500 zephiran containing doryl. Repeated use of doryl in this concentration of zephiran often leads to eventual denudation of the epithelium of the cornea. In one early case where it was used four or five times a day for about one month the patient's eye developed a superficial keratitis and beginning vascularization of the cornea. Reducing the concentration of zephiran to 1:5,000 in this case cleared the cornea of the superficial keratitis but the vascularization continued. The patient had no loss in vision, however. It is, therefore, important to prescribe doryl in weak solutions of zephiran. It is not felt that doryl is the final answer to the problem. It has been found quite effective in cases following cataract extraction, but in a great many cases the use of doryl will not prevent a secondary operation.

Dr. Hardesty, in closing, agreed that doryl seemed more effective in glaucoma following cataract extraction than in other types of glaucoma and that unfortunately it is not a general panacea for glaucoma. It does, however, have a real place in the treatment of glaucoma that is not controlled either by the ordinary miotic or by operation, and thus is a real addition in the methods available for treating glaucoma.

The results of orthoptic training at the Washington University Eye Clinic

Dr. James H. Bryan reviewed the results obtained by orthoptic training on strabismic patients at the Washington University Eye Clinic in the 15 months between May, 1942, and September, 1943, while the orthoptic technician, Miss Anita Steltzer, was available to the Clinic. In that period of time 125 different patients were seen in the Orthoptic Clinic, exam-

ined, their conditions diagnosed, and the future care of their strabismus recommended. Twenty-seven members of this group did enough work with the technicians to make it worth while considering them in this survey. These patients were analyzed and compared with the somewhat similar group that had been seen in the Clinic two years previously and treated with all the various means to correct strabismus with the exception of the work on the machines. It was found that with the exercises: (1) The angle of deviation was not affected in the great majority of cases by the exercises. (2) In the 11 cases of abnormal retinal correspondence 3 patients were cured of the condition; 2 had the angle of anomaly reduced to almost zero, although still somewhat variable; and 6 showed no improvement, although 3 of these 6 should not be considered because they had had less than 10 sessions each. (3) The degree of fusion was improved from no fusion at all to first-degree fusion in one case, and to second-degree fusion in eight cases. Four patients who had no or little fusion ability did not improve in degree. (4) The amplitude of fusion was increased by an average of 24$^{\Delta}$ in six of the nine cases of exotropia. In nine cases of esotropia the range of fusion increased an average of 21$^{\Delta}$. Nine others were not improved. It was concluded that orthoptic exercises were of definite value and should be included along with the other methods available in order properly to treat cases of strabismus.

Discussion. Dr. Benjamin Milder, by invitation, said that it is quite generally agreed that the goal of orthoptic training, together with all other measures in the treatment of strabismus, is the establishment of comfortable binocular vision. To achieve this goal, the orthoptic program pursues somewhat the following sequence: (1) refraction; (2) occlusion, for amblyopia ex anopsia; (3) if anomalous retinal correspondence exists, it must be broken up, and normal regional point-to-point relationship established; (4) suppression must be overcome, if it exists; (5) then, with the ability to superimpose images, amplitude of fusion is developed; (6) stereopsis is stimulated; and (7) the capacity for the eyes to function, with fusion and stereopsis under normal conditions of use, must be developed.

The chief stumbling blocks, he believed, are the above-mentioned numbers 3 and 7. He cited references which showed the achievements realized by others in overcoming the obstacles (Hitz, J., Amer. Jour. Ophth., 1941, v. 24, p. 1017; Berens, C., Elliott, A. J., and Sobacke, L., Amer. Jour. Ophth., 1941, v. 24, p. 1418).

In comparing the report by Dr. Bryan with those of Dr. Hitz and Drs. Berens and Elliott and Miss Sobacke the following points should be considered: (1) the newness of the program at this institution; (2) the small number of cases followed; and (3) the inclusion of some cases which, in retrospect, may have been eliminated as candidates for orthoptic training before they began. In this connection, care must be taken to exclude patients with stubborn amblyopia, low I.Q., marked anisometropia, innervational anomalies (such as alternating hyperphoria), and fixed abnormal retinal correspondence (as evidenced by no signs of improvement in the first 10 treatments).

Perhaps there will be a time when an orthoptician can supervise daily orthoptic training at the grade schools, using Board of Education equipment, during the "orthoptic" period of the daily school routine.

James T. Bryan,
Secretary.

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DEFINITIVE CARE OF THE WAR BLINDED

According to the present plan war-blinded soldiers are sent to one of two hospitals on our east and west seaboards, respectively. They are kept in these hospitals until their wounds have healed and no further medical care is needed, at which time they are sent to Old Farms Convalescent Hospital in Avon, Connecticut, for 16 weeks of careful examination, to determine their capacities for further education or occupation. Here they are also aided in making their individual adjustment to the world of blindness which they have entered. An important item is in the education of their families, who must be taught not to be overly sympathetic, but to have an encouraging yet realistic attitude.

After their discharge from Old Farms, about which time their pension begins and their discharge from the Army takes place, they are released to the Veterans Administration, which organization has the responsibility for their further care, and, incidentally, of distributing their pension to them. The first two phases of the handling of these blinded veterans is being admirably carried out. But the phase of initiating the life-long care that should follow the preliminary work is not being so satisfactorily administered. Quite obviously it is extremely difficult because the soldier is on his own, with money in his pocket, probably in most cases more than he has ever had before, and he wants primarily to get home and forget about the war and the Army. His family also think that his future happiness will be

best served at home where they and his acquaintances can comfort him and possibly help him spend his Army pension.

Our country is justly generous to these men, allowing them $190 per month for life. It is regrettable, however, that there seems to be a tendency to consider that the payment of this allotment is all that need be done and that the man may safely be left to shift for himself, trusting that local organizations for the blind, if any, will interest themselves in his case and give him aid and counsel.

It is understandable that the care of from 500 to 1,000 blinded veterans may seem a very minor matter for an organization that must help an enormous number of veterans handicapped in other ways because of their service in the Armed Forces. However, every single disabled veteran is deserving of the best possible care that can be given him, and this principle should apply to the blind perhaps even more fully than to any other type of war-handicapped, because their incapacity is probably the most difficult for which to make adjustments and certainly is one that is most likely to prevent those afflicted from resuming a normal and happy life.

Blindness constitutes perhaps the greatest change in the physical being, and certainly in the viewpoint, that occurs to any of these soldiers. It, therefore, behooves us to see to it that no stone is left unturned in following through with each of these men to make sure that every chance is being given him. An able director in the Veterans Administration whose only concern is the care of war-blinded is a first requirement. This director should be personally familiar with every one of the war-blinded and upon his release from Old Farms should know exactly where each man is going and what he plans to do. A card-index system should be maintained for these individuals, the local blind agencies contacted, and definite plans made for the occupation of the soldier or his further training if that is necessary. Every bit of red tape should be scrapped and the most direct methods possible employed.

In England this is done very satisfactorily by an essentially private agency known as St. Dunstan's, which acts in full coöperation with the government. For such a duty a private agency is probably not so desirable as is a governmental one. The care of the war-blinded is a national obligation and has been recognized as such by our government when it assigned the definitive care of these soldiers to the Veterans service. This service in all fairness should accept the assignment as an important mandate and should attempt to carry it out in some such manner as is done in England by St. Dunstan's. Whether the idea of a central institute which may serve as a home on occasion for these boys is necessary may be disputed, although the advantage of such a center as a stimulus to the blinded and to the Veterans organization itself cannot be denied. This would be valuable in permitting the blind soldiers to keep in touch with one another and to the organization in maintaining a close relationship with the blinded. But whether or not the central institute is adopted as a part of the program, at least a most careful, intelligent, and continuous follow-up throughout the life of the individual is his due and should be undertaken.

It is natural, perhaps, for ophthalmologists to regard the care of the blinded as quite apart from their own activities because the objective of the ophthalmologists' training has been the restoration and preservation of vision. Few of them have had intimate contacts with the blind or have studied their problems closely. Even so, they must not ignore their obligation since ophthalmologists are held responsible by the public for the care of these unfortunates who have given so much to make life safe and comfortable for them and their children. It behooves

every eye physician definitely to concern himself in the future of these war-blinded, nationally and locally. Eye societies should try to find out when the newly blinded return to their communities and might well appoint committees whose task it would be to keep in touch with these men and make sure that they are not forgotten and that the Veterans organization is doing all that can be done for those thus handicapped in their communities.

Lawrence T. Post.

LOS ANGELES STUDY CLUB

The leaders in the organization known as the Los Angeles Research Study Club are emphatic in attributing to Edward Jackson the inspiration for the creation of this most successful adventure in post-graduate education.

Prior to 1928, Jackson, enthusiastic over the success of the Colorado summer course in ophthalmology and otolaryngology, in whose development he had been the prime mover, suggested to some of his West Coast colleagues that they should establish a similar course under the favorable climatic conditions existing in the winters of Southern California.

At the invitation of Doctors Ray Irvine and M. J. Weymann, Jackson presented in Los Angeles, in January, 1928, a series of lectures on physiologic optics. The following year the ear, nose, and throat surgeons of California organized a short course in those specialties. Then, after a lapse of two years, Dr. Bernard Samuels gave at Los Angeles a midwinter course in the pathology of the eye.

For this course on pathology the "Los Angeles Research Study Club" was formally incorporated, and a combined two-weeks' course in ophthalmology and otolaryngology has been given every winter since then, with the coöperation of teachers from other parts of the United States as well as from abroad.

This year's attendance, including somewhere near one hundred medical guests from the Armed Forces, amounted to approximately four hundred. There was naturally a large attendance from the State of California, but, in all, twenty-seven states were represented, in the north, the south, the middle west, and the Atlantic seaboard.

It has been the custom to place most of the eye work of the Los Angeles course in the first week, and most of the ear, nose, and throat work in the second week. This year the eye events came to a close on Tuesday, January thirtieth. Decision will be made later as to whether in subsequent courses the individual weeks shall be separately allotted to the eye and to otolaryngology, respectively. Many of those present at the final eye luncheon expressed themselves in favor of this procedure.

In view of a recent Government pronouncement or request as to the holding of conventions during the remainder of the war, a conclusion as to whether the Los Angeles Research Study Club shall gather next winter will be reached later.

There can be no question that these meetings, diligently attended, with much use of notebooks, by a large body of specialists furnish a great stimulus to the better practice of ophthalmology and otolaryngology. Physicians who, in the absence of many colleagues overseas, are carrying an extremely heavy load of professional work and responsibility are in need not only of the stimulus afforded by such educational courses, but also of the brief period of relaxation from the daily grind. It is not easy for some of us to understand why there is any lesser degree of justification for travel applied to these purposes among overworked physicians and surgeons than for many other phases of the travel which, quite apart from military necessity, so constantly congests our rail and bus lines.

W. H. Crisp.

ABSTRACT DEPARTMENT

EDITED BY DR. WILLIAM H. CRISP

Abstracts are classified under the divisions listed below, which broadly correspond to those formerly used in the Ophthalmic Year Book. It must be remembered that any given paper may belong to several divisions of ophthalmology, although here it is mentioned only in one. Not all of the headings will necessarily be found in any one issue of the Journal.

CLASSIFICATION

1. General methods of diagnosis
2. Therapeutics and operations
3. Physiologic optics, refraction, and color vision
4. Ocular movements
5. Conjunctiva
6. Cornea and sclera
7. Uveal tract, sympathetic disease, and aqueous humor
8. Glaucoma and ocular tension
9. Crystalline lens
10. Retina and vitreous
11. Optic nerve and toxic amblyopias
12. Visual tracts and centers
13. Eyeball and orbit
14. Eyelids and lacrimal apparatus
15. Tumors
16. Injuries
17. Systemic diseases and parasites
18. Hygiene, sociology, education, and history
19. Anatomy, embryology, and comparative ophthalmology

7

UVEAL TRACT, SYMPATHETIC DISEASE, AND AQUEOUS HUMOR

MacDonald, A. E. **Boeck's sarcoid of retina—miliary form.** Trans. Amer. Ophth. Soc., 1943, v. 41, pp. 200-203.

Prompted by the findings in a case of reticular-cell sarcoma of both eyes, the author reviews his cases of "non-caseating tubercle of the retina" and reports what he regards as a true case of Boeck's sarcoid in miliary form. A woman aged sixty years gave a history of recurrent iritis in the right eye. The eye was observed for two years and was finally enucleated after severe pain. Clinically the iris showed a grayish mass, 5 mm. in diameter, with blood vessels leading to it. Posterior synechias were present. The left eye also had recurrent attacks of iritis with alternate vision limited to large objects. The original pathologic diagnosis of the right eye was sarcoma, but a review of the slide established a diagnosis of Boeck's sarcoid of the retina, by the finding of several masses of miliary sarcoid scattered throughout the retina. (3 photomicrographs.)

Carl D. F. Jensen.

8

GLAUCOMA AND OCULAR TENSION

Gaines, S. R. **The value of central-field studies over the conventional type of visual-field studies.** New Orleans Med. and Surg. Jour., 1944, v. 97, Oct., p. 176.

The author reports six cases of glaucoma to illustrate some of the advantages of central over peripheral fields. More visual fields are taken on glaucoma patients than on patients with any other one condition. It is essential to find the earliest central changes and to watch their progress.

Theodore M. Shapira.

Guerry, Du Pont, 3. **Angiodiathermy of the long posterior ciliary arteries and its use in the treatment of glaucoma.** Amer. Jour. Ophth., 1944, v. 27, Dec., pp. 1376-1393. (10 figures, references.)

Kronfeld, P. C. **The standardization of so-called Schiötz tonometers.** Amer.

Jour. Ophth., 1945, v. 28, Jan., pp. 34-37. (References.)

Masters, R. J. **Notes on an operation for glaucoma.** Amer. Jour. Ophth., 1944, v. 27, Dec., pp. 1371-1373.

9

CRYSTALLINE LENS

Burky, E. L. **The production of lens sensitivity in rabbits by brucella infection.** Amer. Jour. Ophth., 1944, v. 27, Dec., pp. 1394-1395. (References.)

Hughes, W. F., Jr., and Owens, W. C. **Extraction of senile cataract.** Amer. Jour. Ophth., 1945, v. 28, Jan., pp. 40-49. (11 tables, references.) (Also Trans. Amer. Acad. Ophth. and Otolaryng., 1945, 49th mtg.)

Marshall, J. C. **A case of polycythemia vera—extraction of both lenses.** Brit. Jour. Ophth., 1944, v. 28, Oct., pp. 481-486. (See Section 10, Retina and vitreous.)

10

RETINA AND VITREOUS

Benkwith, K. B. **Early ophthalmic findings in a case of spontaneous subarachnoid hemorrhage of the brain.** United States Naval Med. Bull., 1944, v. 43, Sept., p. 535.

A 33-year-old enlisted man became unconscious while he was complaining of headache, dizziness, and sudden ringing in the ears. The fundus of the right eye showed generalized attenuation of the retinal arterioles with very definite foci of spasm. The retinal veins were greatly distended and showed no arteriovenous constriction. Numerous round, pin-point, and flame-shaped hemorrhages gradually made their appearance in close proximity to the veins about 1 to 1.5 disc-diameters from the disc. The number increased, and some coalesced to form large patches of hemorrhage. Later, large, nummular, disc-size, brick-red hemorrhages appeared one to two disc-diameters from the margin of the disc. As the volume of the hemorrhages increased they became dark red. The picture resembled central retinal thrombosis except that the hemorrhages lacked continuity with the disc. After thirty minutes of observation the left eye, too, showed arteriolar spasm and venous congestion but no hemorrhage or papilledema. The patient died three hours later. Autopsy showed massive subarachnoid hemorrhage over the right base of the brain, extending into the right optic sheath, and taking origin from the right anterior cerebral artery at the circle of Willis.

R. Grunfeld.

Clay, G. E., and Baird, M. **Ophthalmoscopic classification of hypertensive diseases.** Amer. Jour. Ophth., 1944, v. 27, Dec., pp. 1396-1403; also Trans. Amer. Ophth. Soc., 1943, v. 41, p. 205. (2 illustrations, references.)

Givner, Isadore. **Clinical studies in angiospasm.** Amer. Jour. Ophth., 1944, v. 27, Dec., pp. 1408-1412. (7 figures, references.)

Klien, B. A. **Obstruction of the central retinal vein.** Amer. Jour. Ophth., 1944, v. 27, Dec., pp. 1339-1354. (19 figures, references.)

Livingston, P. C. **Visual problems of aerial warfare. 1. "Night": studies in the dark-adapted eye.** The Lancet, 1944, v. 247, July 8, p. 33.

The swing of retinal function between rod and cone depends upon the amount of available light. It is known that in full moonlight cone function is dominant, with the assistance of rods

in an advanced but not complete state of adaptation. In good weather, night operations during the summer months are largely within the range of cone vision, suggesting the importance of due consideration of cone activity.

Normally the dark-adapted eye reveals a central scotoma corresponding to the size of the macula when tested by luminous objects below cone threshold. Measurement within small variations is 4 degrees wide and 5 degrees high. Variation in pattern demonstrates that recognition of objects whose illumination is gradually increased is greater and more rapid in those individuals who have the smallest scotoma, or the smallest pure cone area centrally. Likewise those with larger cone areas do poorest at the above recognition. Earlier experiment revealed that form recognition drops rapidly outside of 5 degrees from fixation in the dark-adapted eye. Enlargement of the blind spot is normally found on rod perimetry as is an interesting area of rod hypersensitivity between 12 and 18 degrees above the fixation point.

By these methods vitamin-A-deficient subjects show first an enlargement of the blind spot with early break through to the periphery. The normal central scotoma enlarges beyond physiologic limits, with later a concentric peripheral field contraction.

Rod sensitivity under anoxemic conditions is found to vary widely in different subjects, the cause of which is still open to speculation. It has been found however that rod function is much less resistant to anoxemia than cone function. Owen C. Dickson.

MacDonald, A. E. **So-called primary retinal tuberculosis.** Trans. Amer. Ophth. Soc., 1943, v. 41, pp. 197-199.

MacDonald adds another case of so-called primary retinal tuberculosis to the two cases previously reported by O'Sullivan and Story and by Hancock. The salient clinical feature of these two cases was the brilliant white reflex seen ophthalmoscopically. MacDonald's case had a similar reflex. Pathologic examination of his case revealed many mononuclear leucocytes in the iris and ciliary body. Two areas of caseation were seen in the retina. No giant cells were detected. MacDonald suggests that absence of giant cells was probably due to the early phase of the disease. (3 photomicrographs, references.) Carl D. F. Jensen.

Marshall, J. C. **A case of polycythemia vera—extraction of both lenses.** Brit. Jour. Ophth., 1944, v. 28, Oct., pp. 481-486.

In a case of polycythemia vera a cataract was removed from each eye with excellent result. The primary form of polycythemia is distinguished from secondary forms and the characteristic fundus lesions are described. (References, 2 colored illustrations.)

Edna M. Reynolds.

Robertson, G. W., and Yudkin, J. **Effect of age upon dark adaptation.** Jour. of Physiology, 1944, v. 103, June, p. 1.

Disagreement as to the effect of age upon dark adaptation is considered due to differences in technique of measuring dark adaptation. In their measurement of dark adaptation (final rod-threshold) in 758 factory workers between the ages of 14 and 71 years, these investigators have found a progressive lowering of the power of dark adaptation with advancing years. The deterioration varies in different decades, the greatest being between fifty

and sixty. Progressive decrease in size of the pupil explains this deterioration quantitatively. Comparison of individual values with any normal standard is not considered satisfactory, since the normal range of dark adaptation is fairly wide. Francis M. Crage.

Sheard, C., Wagener, H. P., and Brunsting, L. A. **Disturbances of visual adaptation and their clinical significance.** Proc. Staff Meetings Mayo Clinic, 1944, v. 19, Nov. 1, p. 525.

The physiology and chemistry of dark adaptation and the criteria for its precise measurement are fully described.

Since vitamin A is a constituent part of the photosensitive pigment of the rods and, perhaps, also of the cones, night blindness can be produced in some instances through dietary avitaminosis A. Similarly night blindness will result in cases in which the vitamin A of the normal diet cannot be absorbed in the gastrointestinal tract, or in cases of malnutrition due to ulcerative colitis. On the other hand, feeding with large doses of vitamin-A concentration in frank conditions of vitamin-A deficiency will result in a recovery, which, however, may require weeks or months.

The tissues of the skin need carotene and vitamin A for their nourishment. Inadequate amounts of vitamin A in the blood and tissues may be found in certain skin diseases, such as pityriasis rubra pilaris and keratosis follicularis, and in these diseases the threshold of dark adaptation is very high. The liver is a great storehouse of vitamin A. Diseases of the liver, such as cirrhosis, are commonly associated with abnormal dark-adaptation curves.

The concentric contractions of the visual fields and the typical dark-adaptation curves may be used clinically as points in differential diagnosis between primary pigmentary degeneration of the retina and inflammatory disorders. In some dyskeratotic diseases, although the threshold level of dark adaptation was found to be very high, the patients seemed to be well nourished and carotene was found in excess in the blood. We must assume that in these cases there was some disturbance of the mechanism for converting carotene into vitamin A, a process which takes place in the liver, although the commonly used liver-function tests failed to reveal any liver damage.

R. Grunfeld.

Stallard, H. B. **Retinal detachment; 78 cases in the Middle East.** Brit. Med. Jour., 1944, Sept. 9, p. 329.

This article supplies statistics on 78 cases of retinal detachment, including 13 cases caused by cystic degeneration, 21 by choroido-retinal degeneration, 3 by myopia, 23 by civil trauma, and 18 by military trauma. All but two of the 78 cases were operated upon by combined surface and penetrating diathermy. The important features of the tears and special details in the cases operated upon are described. A table giving the postoperative results indicates 100 percent success in the cystic-degeneration and choroido-retinal-degeneration groups, both totalling 34 cases. Least favorable were the war trauma cases. Francis M. Crage.

11

OPTIC NERVE AND TOXIC AMBLYOPIAS

Ford, Rosa. **Retrobulbar neuritis (five cases) due to paranasal sinusitis.** Brit. Jour. Ophth., 1944, v. 28, Oct., pp. 511-515.

The five cases showed marked visual

defects. The duration of symptoms varied from two months to 29 years. All showed remarkable improvement in the vision following continuous drainage of the sinuses. In every case the sinusitis was silent.

Because of the prompt and steadily progressing visual improvement, the author believes that in these cases the term "pressure paresis of the optic nerve" is more suitable than "retrobulbar neuritis." (References.)

Edna M. Reynolds.

12

VISUAL TRACTS AND CENTERS

Livingston, P. C. **Visual problems of aerial warfare. 2. "Day": studies of photopic vision.** The Lancet, 1944, v. 247, July 15, p. 67.

The organ of sight, when weak in some part, develops a compensatory mechanism, reflected in an adjustment of function within the cerebral cortex, which goes far to overcome the defect. It is not so much the presentation of an abnormal pattern resulting from an inherent defect which defeats the accuracy of analysis; it is an alteration in that pattern.

This accounts for the frequent tolerance of high astigmatic errors, and possibly the intolerance of small errors. Cases referred for refraction, especially under the stress of war, fall into two groups, (1) the tolerant, basically calm; and (2) the intolerant, those tuned to a higher cortical pitch. If a possible cause for visual irritation is discovered in the intolerant, it should be corrected. Indications for treatment are: (a) a sensation of relief emphasized by the patient with the correction; (b) great sensitivity to change of axis while rotating a small cylinder; (c) appreciation in an abnormally high degree of small alterations in spherical power. Any of these suggest that effort in seeing has been transferred from the subconscious to conscious levels.

Factors influencing design of goggles for flying personnel include (1) adjustable interpupillary distance to allow quantity production; (2) use of safety glass to protect against shattering or flame; (3) design to give the greatest possible field of vision, accomplished partly by use of a double glass with two windows on each side, necessary because the safety glass cannot be ground on a high curve; (4) lightness to avoid the effects of gravity in flight.

Closed-cabin flying makes use of spectacles possible, with advantage in enlarged field and decrease in misting, but with the disadvantage of decreased protection.

Contact lenses have not been perfected to the place where they are of significant value except in isolated instances.

Glare has been controlled by use of "polaroid" or by Crookes B2 lenses.

Heterophorias can first be broken into two groups—those which are present from an early age, and usually stable, and those acquired, usually being unstable. The former commonly produce no symptoms while the latter do. The psychologic effect on the flier when elements of eyestrain develop are tremendous and difficult of evaluation. The consciousness of the need for effort in focusing results in discomfort, irritability, and eventually fatigue—a fatigue which may develop into a neurosis.

The author presents charts giving the results of orthoptic treatment in regard to exophoria, esophoria, and convergence insufficiency. Orthoptic study of 1000 cases of heterophoria re-

veals the greatest advantage from training in convergence weakness and uncomplicated exophorias. Those cases complicated by a strong psychologic factor do not respond readily to any training. Esophoria approaching strabismus, exophoria complicated by neglect, and hyperphoria exceeding 3 prism diopters offer serious barriers to treatment. In training of the heterophorias 242 of 700 have qualified as pilots, 214 have reached the solo flying stage, while 38 failed to pass the ground examinations. The remainder were reclassified for various reasons. In addition to the correction of the phoria, reinforcement of stereopsis is important because of the demands of present flying.

Central vision in the light-adapted eye appears little affected by anoxemia even up to the point of unconsciousness. Ophthalmoscopic examination reveals definite bluing of the disc under anoxemia. However, the effort required to maintain binocular concentration as tested by parallax cannot be sustained at high altitudes, while both accommodation and convergence decrease over a gradual curve with increase in anoxemia.

At extreme altitudes depression of the periphery of the visual field and localized regions of depression within the field occur. Further research may indicate whether this is due to nitrogen in the capillaries of retinal or of calcarine regions. The potential seriousness of the latter is apparent.

Owen C. Dickson.

13

EYEBALL AND ORBIT

Rogalski, T. **A contribution to the study of anophthalmia with description of a case.** Brit. Jour. Ophth., 1944, v. 28, Sept., pp. 429-440.

A case of left anophthalmia with a left-sided harelip is reported. The left palpebral fissure was narrower and shorter than the right, as a result of fusing of the eyelids near the lateral angle. The medial angle of the palpebral fissure was bisected by a ridge of skin that began in a shallow groove connecting the orbit with the harelip. This ridge of skin ran upward and laterally into the conjunctival cavity. At the lateral end of the ridge a black spot was visible through the conjunctival covering.

Dissection of the right orbit showed the contents to be entirely normal. The left orbit, however, showed the left ophthalmic artery to be one third narrower than the right, and the left optic nerve was completely absent. The left optic foramen was smaller than the right and the ophthalmic artery was the only structure passing through it. The left orbit was distinctly smaller than the right. The left nasolacrimal canal was closed by a thin membrane at its nasal end.

Some of the contents of the left orbit were normal in appearance. The left lacrimal gland was well developed and the lacrimal puncta and canaliculi were present in both eyelids, but there was a bifurcation of the lower canaliculus to form two parallel channels.

The fundus of the conjunctival cavity was composed of dense fibrous tissue into which the orbital muscles were inserted in normal relative positions. No vestige of retinal structure, of optic nerve, of lens, or of hyaloid artery could be found in the left orbit.

Analysis of the contents of the left orbit showed that the mesodermal structures, situated external to the eyeball, were well developed, but that the eyeball itself was represented only by its anterior part, including vestiges of

cornea and sclera and of muscles and vessels. Among the parts to which the surface ectoderm gives rise, there were vestiges of everything but the lens. The lacrimal apparatus showed only slight maldevelopment.

The author suggests that the apparently independent development of the retina proper and the pigment epithelium, which have a common origin in the optic outgrowth, may be due to a difference in their blood supply.

Definitions of anophthalmia (complete and consecutive) and microphthalmia are given. The case presented belongs to the consecutive type of anophthalmia, in which the optic vesicle has certainly been formed but has atrophied in the very early stages, leaving as its vestige more or less malformed pigment epithelium. (6 figures.)

Edna M. Reynolds.

14

EYELIDS AND LACRIMAL APPARATUS

Dimitry, T. J., and Mijares, I. **The treatment of trichiasis with choline.** Amer. Jour. Ophth., 1944, v. 27, Dec., pp. 1425-1427.

Foster, John. **Reconstruction of the lower lid by Hughes's method.** Brit. Jour. Ophth., 1944, v. 28, Oct., pp. 515-519.

Two cases of reconstruction of the lower lid following surgical removal because of basal-cell carcinoma unsuitable for irradiation are described. Because of the difficulty of anesthetizing the inner surface of the tarsal cartilage and conjunctiva, the author recommends the use of intravenous anesthesia. (8 photographs.)

Edna M. Reynolds.

Gordon, S., and Cragg, B. H. **Congenital ectropion associated with bilateral ptosis.** Brit. Jour. Ophth., 1944, v. 28, Oct., pp. 520-521.

Congenital ectropion of all four eyelids was associated with ptosis of the upper lids. The patient's father, two brothers, and one sister had similar defects, although not so marked. Lashes were normal in position and distribution, and there was no clinical or X-ray evidence of bony abnormality of the face. There was an alternating hyperphoria and alternating convergent strabismus of about 15 degrees. Vision was 6/12 in each eye and a high degree of hyperopic astigmatism was present. Lenses did not improve vision. The fundi were normal. A thin Thiersch was placed in each upper lid and Wolff grafts in the lower lids. Four months later, fascial slings to the frontalis muscle were placed to overcome the ptosis. (2 photographs.)

Edna M. Reynolds.

15

TUMORS

Cordes, F. C. **Bilateral metastatic carcinoma of the choroid, with X-ray therapy to one eye.** Amer. Jour. Ophth., 1944, v. 27, Dec., pp. 1355-1370; also Trans. Amer. Ophth. Soc., 1944, v. 42. (6 figures, bibliography.)

Jackson, Harvey. **Orbital tumors.** Brit. Jour. Ophth., 1944, v. 28, Sept., pp. 472-478.

This was the subject for discussion at a meeting of the Royal Eye Hospital Clinical Society. Holmes Smith, the Chairman, pointed out that considerable interest had been caused by Dandy's book on orbital tumors in which he claimed that most orbital tumors had intracranial extensions and should be dealt with through the transfrontal approach by the neurosurgeon and not

merely tinkered with by ophthalmic surgeons in Krönlein operations.

Jackson remarks that the most frequent and commonly the earliest symptom is unilateral proptosis. Disturbances of vision are often realized simultaneously with protrusion of the eye. Pain fails to play a part in the average history of an orbital-tumor case. This surprising freedom from pain is probably due to the chronicity of the majority of the lesions. The development of a mass discernible to the patient is infrequent. Other, less frequent, clinical signs of orbital tumor are ptosis or edema of the lids, chemosis, cranial nerve palsies, audible bruits, and formation of a discharging sinus resulting from secondary infection. Ophthalmoscopic examination reveals papilledema in optic-nerve tumors and optic atrophy in other types. The duration of symptoms when fully established may be very great. A period of from 12 to 20 years is not exceptional. Radiologic verification is possible in a high percentage of cases.

It is the opinion of the author that the Krönlein operation has little to offer because of the limited field it provides, the unsightly scar that it leaves, and the diplopia which so often results. He prefers the transcranial operation, on which the orbit is explored through its roof by a trained neurosurgeon. The scar is hidden and a much wider field of exploration is secured. (References, 7 figures.)

Edna M. Reynolds.

Michaelson, I. S. **Angioma of the retina.** Brit. Jour. Ophth., 1944, v. 28, Oct., pp. 522-526.

A case of angioma of the retina in which a tear as well as a tumor of the retina was present is reported. Surface diathermy was applied over the site of the tumor and over the site of the tear. Visual acuity improved from 6/36 to 6/9 and the visual field was enlarged. The tumor appeared to be occluded. The feeding artery was normal in size and the draining vein could not be traced. (2 fields, 2 drawings.)

Edna M. Reynolds.

Town, A. E. **Myxoma of the lower eyelid.** Amer. Jour. Ophth., 1945, v. 28, Jan., pp. 68-69. (One figure.)

Wolff, Eugene. **A note on the rosettes, nature, and nomenclature of "glioma retinae."** Brit. Jour. Ophth., 1944, v. 28, Sept., pp. 448-450.

The columnar cells constituting rosettes are shown to be identical with the neuroepithelium of the third or fourth month of gestation. From the general form of the cells, and the presence of an external limiting membrane and diplosomes, there can be little doubt that the rosettes represent developing rods and cones. (5 figures, references.) Edna M. Reynolds.

16

INJURIES

Adamiuk, V. E. **Therapeutic transplantation of skin.** Viestnik Oft., 1943, v. 22, pt. 4, p. 12. (See Section 2, Therapeutics and operations.)

Callahan, Alston. **Eye injuries at an aircraft plant.** Jour. Med. Assoc. Georgia, 1944, v. 33, Oct., p. 312.

A series of 404 eye injuries observed at an aircraft plant between January, 1942, and October, 1943, is presented with an evaluation of some of the clinical and therapeutic problems encountered. In most cases the traumatic agents in these cases were either particles of concrete or of similar substances or of various types of metal, particu-

larly aluminum and light alloys used in the construction of airplanes. A technical procedure evolved for the removal of minute foreign bodies from the cornea is described. Attention is called to the chemical sensitiveness of the eye to aluminum particles; and two cases of successful extraction of intraocular foreign bodies are dedescribed. Theodore M. Shapira.

Cherkasky, E. B. **The best time to enucleate crushed eyes.** Viestnik Oft., 1943, v. 22, pt. 4, p. 28.

In grave war injuries leading to destruction of the eyeball there is usually severe conjunctival chemosis and ocular immobility caused by retrobulbar hemorrhage or orbital damage. Frequently the picture is mistaken for panophthalmitis and so the eyeball is eviscerated. Cherkasky is opposed to evisceration because he fears that uveal particles may be overlooked and become the source of sympathetic ophthalmia. Enucleation can be performed more easily and the postoperative recovery is smoother if the operation is done after the traumatic reaction subsides. He therefore urges delay of the operation for 20 to 25 days, until the orbital hemorrhage is absorbed and ocular motility is restored. Experience in war injuries has shown that frequently a foreign body passes through the eyeball and lodges in the cranium. For this reason such cases should be X-rayed before the eyeball is removed, and the latter should be done only when the conjunctival sac becomes free from purulent secretion. Ray K. Daily.

Cogan, D. G. **Lewisite burns of the eye.** Jour. Amer. Med. Assoc., 1943, v. 122, June 12, p. 435.

Two instances of ocular lesions in man resulting from exposure to lewisite droplets and gas are reported. The chief manifestations were in the superficial cornea, and caused severe epiphora, photophobia, redness, and swelling. There was no permanent damage. The relative mildness of the ocular lesions is probably accounted for by the prompt epiphora which flushes out the irritant, as contrasted with the latent period of mustard gas.

Robert N. Shaffer.

Golitsyn, N. D. **Action of land mines, directed at the infantry, on the eye.** Viestnik Oft., 1943, v. 22, pt. 4, p. 30.

These mines striking at close range are very destructive, damaging the face, the eyes, and other parts of the body, and are frequently fatal. In 80 percent of the cases they produced complicated burns of the face with damage to the bones of the face and orbit, and perforations of the eyeball. Their effects differ from the injuries produced by mines directed at the artillery, in that the latter, exploding further away, do not produce burns. In 40 percent of the cases there were also injuries to the upper or lower extremities.

The burns of the face usually involve the lids, the conjunctiva, and the cornea, with the formation of vesicles and subsequent swelling of the conjunctiva and cornea, as well as maceration and desquamation of the epithelium. Of these injuries 24 percent were slight, 68 percent severe, and the others fatal. In the fatal cases there were perforating injuries of the eyeball, orbit, and skull, and prolapse of brain tissue.

The clinical course of slight injuries is as follows: On the first day the swelling and edema are so extensive that inspection is impossible without lid elevators. After one to three days of treatment the injured begin to discern figures and outlines. Burns of the

cornea are very severe. Some cases show rupture of the cornea, traumatic cataract, and prolapse of vitreous. The explosions also produce contusions, hemorrhages in the conjunctiva, vitreous opacities, and hemophthalmos.

Treatment was by the open method, painting the skin with 3 percent potassium permanganate, and irrigating the eyes with a 1 to 4000 solution. In perforating wounds sulfanilamide powder was used. Except in perforating injuries bandages were avoided.

Ray K. Daily.

Krol, A. G. **Surgical procedure in lid injuries.** Viestnik Oft., 1943, v. 22, pt. 4, p. 6.

According to Russian data injuries of the lids constitute 11 percent of all ocular injuries. Incorrect handling of these injuries leads to the formation of thick scars, colobomas, and synechias between the lids and conjunctiva. The patient is thus left with a cosmetic deformity and disturbed function. Failure to do a primary repair of the lids, and waiting for cicatrization, keep the wounded in the hospital unnecessarily for months, and the results of late repair are not always satisfactory. Failure to undertake primary repair is usually due to fear of infection. But in reality the danger of infection of the lids is minimal, because the abundant vascularization of the tissues and the thinness of the muscle tissue insure excellent nutrition. War surgery has demonstrated that the earlier the repair of the lids is performed the better the results. Analysis of 64 patients, 23 of whom were operated upon within one to 22 days of the injury in field hospitals, and 41 at base hospitals from one to three months after the injury, shows that injuries of the lids should receive primary repair in field hospitals, and when hospitalization is late they should have immediate repair and remain in the hospital until the sutures are removed. The wound should be repaired even if the wounded reach the hospital after a delay of 1 to 3 weeks, and one should never wait for complete cicatrization of the wound. In operating, every millimeter of tissue should be carefully saved. In wounds through the entire thickness of the lids the conjunctiva and the skin should be sutured separately, and the lids should be totally immobilized for four days with a binocular bandage. Postoperative physiotherapy is of value in reducing the density of the cicatrices.

Ray K. Daily.

Kronenberg. Bernard. **A case of intralenticular foreign body with early removal.** Amer. Jour. Ophth., 1944, v. 27, Dec., pp. 1427-1428.

Mann, Ida. **A study of eighty-four cases of delayed mustard-gas keratitis fitted with contact lenses.** Brit. Jour. Ophth., 1944, v. 28, Sept., pp. 441-447.

The cases reported were diagnosed on the history and on the finding of mustard-gas scars with corneal degeneration (fat and cholesterine), varicose conjunctival and corneal vessels, and avascular scars on the interpalpebral conjunctiva. Roughly half of the cases had a long quiescent interval between exposure and the beginning of the ulceration stage. The only complaint during this time was alteration of refraction. The recurring ulcers heal but leave faceted scars which gradually diminish visual acuity.

Wearing contact glasses does not entirely prevent breakdown, but in many cases retention of vision and continuance of work has been made possible for as much as seven years. In all but

two cases, moreover, there was great improvement in vision with contact glasses. Thirty-nine of the patients wear their contact glasses eight hours or more a day. Twenty of these patients have had one or more relapses since wearing the glasses. Five patients have been unable to wear contact lenses, and eight patients wear their lenses less than five hours a day. (One graph, 2 tables, references.)

Edna M. Reynolds.

Michaelson, I. C. **Incomplete avulsion of the eye.** Brit. Jour. Ophth., 1944, v. 28, Sept., pp. 458-460.

The case is reported because of the remarkable functional recovery. A soldier assaulted the patient, and attempted to gouge out his right eye with a spike-ring. There was a clean-cut, oval, incised wound through the upper and lower lids, including the conjunctiva. The globe was proptosed between the edematous tissues and could not be replaced. All four recti muscles were completely severed from their global attachments. The vitreous showed extensive hemorrhage, which together with the corneal haze prevented a view of the fundus. The visual acuity was perception of hand movements.

Under general anesthesia the recti muscles were sutured to their insertions, the conjunctival wound was closed, and the lids were brought back in position. After seven weeks the vision was 6/24 and the vitreous had greatly cleared. After 16 months, when the patient was seen again, he was complaining of some diplopia when looking forward and to the left. The right eye showed some divergence and some limitation in adduction. The right eye showed a pronounced optic atrophy. With central acuity of 6/9, the visual loss was not in keeping with the marked pallor of the disc. The field showed some concentric contraction and a small paracentral scotoma.

The right external rectus muscle was lengthened surgically. At the time of discharge, all movements of the eyes were good except that there was adduction of the right eye in binocular use. (One field, 3 figures.)

Edna M. Reynolds.

Mitzkevich, L. D. **Wounds at the inner angle of the lids and treatment of the resulting defects.** Viestnik Oft., 1943, v. 22, pt. 4, p. 10.

In repair of injuries of the lower lid at the inner canthus, Mitzkevich pulls up the torn loose end of the lid into a pocket formed high up under the skin of the inner canthus, and sutures it there with two mattress sutures. The buried end of the lid should be denuded of the outer skin layers. This procedure fixes the lid firmly in its place and avoids the ectropion and eversions so commonly seen in end-to-end repair of such wounds. (Illustrations.)

Ray K. Daily.

Muraviev, B. G. **A modification of Keller's method in localization of intraocular foreign bodies.** Viestnik Oft., 1943, v. 22, pt. 4, p. 37.

The author's modification consists in dividing the exposure time unequally, to produce two X-ray shadows of unequal intensity. The patient looks down for one-third of the exposure time, and up for two-thirds. If the lighter shadow on the roentgenogram is found below the denser one, the foreign body is located in the anterior ocular segment while if their position is reversed it is in the posterior ocular segment. This method may be used when equipment required for more accurate localizing methods is unavailable, and is suitable

for foreign bodies not less than 1 mm. in size. Ray K. Daily.

Pfeiffer, R. L. **Localization of intraocular foreign bodies by means of the contact lens.** Arch. of Ophth., 1944, v. 32, Oct., pp. 261-266.

The removal of magnetic foreign bodies by the hand magnet is somewhat replacing the grosser technique employing the giant magnet. This more refined technique calls for more accurate localization. With consummate care it is possible for a roentgenologist to localize a foreign particle in the eye with greater accuracy than the surgeon can utilize at operation.

Bone-free roentgenography, employing dental film, is of value both in the diagnosis and localization of fragments in the anterior 8 to 12 mm. of the eye. For more general use, localization is carried out by means of the Comberg contact lens. This lens differs from optical contact lenses in that it contains four lead markers to indicate the limbus. With the contact lens in place, two exposures are made, a posteroanterior and a lateral. These two exposures make it relatively easy to determine the position of the foreign body in relation to the four lead markers. The method of plotting the position graphically is described. The author states that this method is accurate, simple, easy to perform, and adaptable, and that it requires a minimum of apparatus. (7 figures, references.)

John C. Long.

Pierce, G. W. **Some useful plastic procedures in ophthalmology.** Trans. Amer. Acad. Ophth. and Otolaryng., 1944, 48th mtg., May-June, pp. 309-332.

After complete excision of an apparently small scar, an appalling defect often results. Only experience teaches the best selection of materials for repair of the part. Nine illustrative cases are recorded.

A severe ectropion of the lower lid following a boiler explosion was successfully treated with a skin graft from the back of the ear. Ptosis following a conjunctival burn complicated by orbital infection was improved by insertion of two subcutaneous fascia-lata strips. These extended from slightly below the tarsal fold to a half inch above the brow.

Obliteration of the cul-de-sac following a lime burn was remedied by a thin Thiersch-graft inlay fitted on a bisected wax mold. Scar tissue was previously completely excised. A similar problem was solved by scar-tissue excision and the restoration of the lower cul-de-sac by mattress sutures from the conjunctiva downward through the lower lid.

Entropion was improved by a modified Machek-Blaskovics operation. Extensive melanoma of the lower lid was excised and the lid repaired with a pedicled flap from the temporal end of the upper lid.

After a bullet wound, the orbit was reconstructed with a Thiersch graft splinted with dental modeling-wax. An acrylic plug was placed in the orbital apex on which rested the prothesis. A preserved refrigerated cartilage-implant was placed subperiosteally in the floor of the orbit to raise the eyeball and relieve diplopia following a crushing fracture of the malar bone. (21 photographs, 34 diagrams.)

Charles A. Bahn.

Popov, M. Z. **Pathogenesis of the fundus changes in complicated craniocerebral injuries.** Viestnik Oft., 1943, v. 22, pt. 4, p. 19. (See Section 12, Visual tracts and centers.)

Protopopov, B. V. **Signal forceps for removal of nonmagnetic intraocular foreign bodies.** Viestnik Oft., 1943, v. 22, pt. 4, p. 29.

The author has devised a forceps connected with an electric current and a small light bulb. A piece of metal between the blades of the forceps closes the circuit, the fact being indicated by the lighting of the bulb. The foreign body is localized by X ray. After a scleral incision over the foreign body the forceps is introduced into the wound and attempts are made to grasp the foreign body. In one case the lamp was lit immediately after the introduction of the forceps and the foreign body was easily extracted. In three cases it was removed after a long search. In two cases the attempt failed. In one of these the eyeball was enucleated and it was found that the foreign body had not been correctly localized by the X ray, and was enveloped by a dense exudate so that the forceps could not come into contact with it. In the second case the foreign body had been in the eyeball for a month, and had also probably become firmly encapsulated.

Ray K. Daily.

Sherman, A. R. **Eye injuries in industry and determination of their disability.** Jour. Med. Soc. New Jersey, 1944, v. 41, Sept., p. 332. (See Section 18, Hygiene, sociology, education, and history.)

Smelanski, R. I. **Orbital foreign bodies.** Viestnik Oft., 1943, v. 22, pt. 4, p. 24.

In industrial injuries orbital foreign bodies are rare, because a sharp metallic particle usually penetrates and becomes arrested within the eyeball. Foreign bodies in the orbit result from double ocular perforations, and it is generally agreed that they are best left alone. In war injuries the foreign bodies are large, and penetrating at a great velocity they are powerful enough to pierce the bony walls of the orbit, and sometimes of both orbits, at times missing the eyeball. The important symptoms due to intraorbital foreign bodies are exophthalmos, limitation of ocular motility, ptosis, edema of the upper lid, and edema or chemosis of the conjunctiva. Chemosis is a very important symptom, and the persistence of chemosis without inflammatory symptoms is very suggestive of the presence of an intraorbital foreign body. The ocular symptoms are those of contusion; paralysis of the sphincter, iridodialysis, vitreous hemorrhages, and ruptures of the choroid and retina. Localization of the foreign body is very difficult even with X ray, and so is its extraction, even with the giant magnet. A foreign body held firmly by the tissues of the orbit or its bony walls is not dislodged by the electromagnet. Surgery in such cases should not be undertaken hastily. While it is recognized that all intraocular foreign bodies should be removed immediately and there must be special indications to justify delaying the operation, in intraorbital foreign bodies the situation is reversed. Surgery should not be undertaken without definite indications. These are symptoms of beginning orbital infection, pressure symptoms caused by a large fragment, and beginning meningitis. Extractions should be undertaken after careful X-ray localization, and one should have available a giant magnet and a radiolocalizer. The author's material consisted of 47 surgical cases. There were 41 metal fragments, 4 bullets, and in two cases the orbit contained pieces of bone; in one case it was the bone of a horse blown up by a mine, and in the

other a piece of the patient's own leg. The foreign bodies were localized as follows: 24 in the anterior portion of the orbit, 24 in the posterior portion, and 3 in the ethmoids. The eyeball was saved in 32 cases; in 29 with satisfactory vision and in 9 without vision. In 15 cases the eyeball was gravely injured. Of 45 foreign bodies, 30 were extracted through orbitotomies, one case by means of Kroenlein operation. Twenty-two foreign bodies were extracted with the giant magnet, and 6 with the aid of the radio-localizer.

Ray K. Daily.

Wiener, Meyer. **The treatment of recent injuries to the eye and adnexa.** Trans. Amer. Acad. Ophth. and Otolaryng., 48th mtg., 1944, July-Aug., pp. 425-435.

All bleeding should be stopped before anything else is done. Digital compression, if properly carried out, will always temporarily control the major part of the bleeding. All bleeding vessels should be tied with silk ligatures cut short and left buried. Blood transfusions are indicated if the patient is in shock. General anesthesia may be necessary during the process of cleaning and preparing the wound. The cutting away of all lacerated and mashed tissues as was generally practiced during World War I has given way to more conservative methods. Wounds must not be disturbed too often for inspection. Adequate tetanus toxoid should always be promptly administered in deep wounds, especially if the opening is small. Gas-gangrene serum is indicated if the risks justify. Necrotic material and pus should be eliminated before administering sulfonamide therapy. Primary wound closure is usually dangerous, and with few exceptions wounds should be left open. Not more than 10 gm. of sulfanilamide should be used locally on any patient within a 24-hour period.

In severe heat-burns of the body, intravenous plasma should be used immediately. Avoid débridement or cleansing, using only sterile boric-acid strips secured by pressure bandages. Skin grafts, if necessary, should be used promptly. Granulation tissue should be removed. In perforating cuts of the lids, avoid loss of marginal conjunctiva.

In deep lid cuts, deep sutures should be used before suturing the skin. Patients requiring plastic repair should receive only prophylactic measures by eye surgeons not trained in plastic surgery. These patients should only be operated upon where experienced plastic surgery is available.

Generally speaking, magnetic intraocular foreign bodies are best removed with a powerful magnet and through the sclera. The scleral incision should be made with a very sharp cataract knife, and should be considerably larger than the estimated diameter of the foreign body, and as near the localized point as possible.

All injuries to the ciliary body produce eyes potentially subject to sympathetic ophthalmia. Enucleation is advised at the first sign of eyeball shrinkage, such as pitting of the injured eye. Scleral ruptures practically always mean loss of the eye. Retinal detachment due to traumatism responds especially well to electric coagulation. Iris prolapses should be excised and not replaced. If possible, wait until all irritation has subsided before operating on perforating lens injuries. Dislocated lenses, unless removed, nearly always result in increased intraocular tension and loss of the eye.

Conjunctival and corneal burns due

to alkalies or acids should be treated by prompt flushing of the conjunctival sac with water, using considerable force. In superficial burns, use cool compresses; in deep burns from lye or other escharotics, warm applications should be used. In lye burns, as long as the conjunctiva and underlying sclera remain red, one need not fear more severe damage to the cornea than exists. Pickrell's solution of 3 percent sulfadiazine in 8 percent trienthanolamine sprayed over the surface of heat burns involving the face or lids seems the best immediate treatment thus far used. First aid in gas burns consists of several minute irrigations with any bland nonirritating solution. Use atropine if the cornea is involved; also sulfathiazole ointment or jelly to help prevent secondary infection. Lewisite burns should be treated by irrigation with one or two percent sodium-bicarbonate solution. (References.)

Charles A. Bahn.

17

SYSTEMIC DISEASES AND PARASITES

Campbell, A. M. G., and Cross, A. G. **Ocular neurosis.** Brit. Jour. Ophth., 1944, v. 28, Aug., p. 394.

The incidence of ocular neurosis in wartime is estimated at 34 percent, as compared with 15 to 16 percent in peacetime. Fourteen cases are reported, and the fact is emphasized that the basis of a neurotic reaction is any factor which induces an abnormal awareness of the ocular mechanism. Most of the cases reported are of chronic anxiety neurosis. The author suggests better education of the public, to bring about an intelligent realization of the strength and potentialities of the normal eye, and eradication of the belief that close study and working in artificial light damage the eyes.

Edna M. Reynolds.

Chesney, A. M., and Woods, A. C. **Further observation on the relation of the eye to immunity in experimental syphilis. 2. The development of immunity after primary intracorneal inoculation.** Jour. Exper. Med., 1944, v. 80, Nov. 1, p. 357. (See Section 6, Cornea and sclera.)

Chesney, A. M., and Woods, A. C. **Further observations on the relation of the eye to immunity in experimental syphilis. 3. The influence of a nonspecific inflammatory reaction in the cornea on the development of immunity in that tissue after intratesticular inoculation.** Jour. Exper. Med., 1944, v. 80, Nov. 1, p. 369. (See Section 6, Cornea and sclera.)

Dodds, G. E. **Mucocele of maxillary antrum.** Brit. Jour. Ophth., 1944, v. 28, Oct., pp. 510-511.

A mucocele of the left maxillary antrum is described and illustrated. Definite proof of the diagnosis could not be obtained. (2 photographs.)

Edna M. Reynolds.

Friedenwald, J., and Buschke, W. **The effects of excitement, of epinephrine, and of sympathectomy on the mitotic activity of the corneal epithelium in rats.** Amer. Jour. Physiology, 1944, v. 141, July 1, p. 689. (See Section 6, Cornea and sclera.)

Gözcü, N. I. **Retinal hemorrhages as complications of malaria.** Göz Klinigi, 1944, v. 1, no. 5, p. 187. (See Section 10, Retina and vitreous.)

18

HYGIENE, SOCIOLOGY, EDUCATION, AND HISTORY

Alvis, B. Y. **Defective vision in industry.** Industrial Med., 1944, v. 13, July, pp. 537-539.

Industrial efficiency of groups of workers has a definite relation to the adequacy of their vision. Workers doing superior work for which their visual equipment theoretically or actually is not ideal compensate for their visual handicap by the factors of superior intelligence and training and experience. We must know the shortcomings of the workers so that they are not assigned tasks for which they do not possess the essential visual faculty. Safety and efficiency on the job are to be maintained, and danger to life and property from faulty vision must be avoided. The "art of seeing" is a composite of visual attributes including visual acuity, fusion and stereopsis, muscle balance and coördination, color appreciation, range of accommodation, and condition of visual fields. It is advisable to keep a record of the employee's ability in each of these components, first to direct placement, but also as a matter of record in case claims arise following accidental injury.

M. Lombardo.

Crisp, W. H. **Edward Jackson's place in the history of refraction. (First Jackson Memorial Lecture.)** Amer. Jour. Ophth., 1945, v. 28, Jan., pp. 1-12; also Trans. Amer. Acad. Ophth. and Otolaryng., 1944, 49th mtg., p. 47. (Bibliography.)

Duke-Elder, Stewart. **Caring for the eyes of Britain's Army.** The Military Surgeon, 1944, v. 95, Aug., p. 105.

The ophthalmic services of the British Army have become revolutionized in the course of the war. At the periphery are the Mobile Ophthalmic Units, one to each corps, serving the needs of the front line. These units are carried on two trucks, one acting as an ophthalmic consulting room, the other as a spectacle shop. They carry an ophthalmic specialist and a sergeant optician, and full equipment for ophthalmic examination and treatment, including a giant magnet, diathermy, a generator, lenses, frames, and the necessary optical mechanical equipment.

The prompt treatment of minor eye casualties, including superficial foreign bodies, abrasions, conjunctivitis, and the remedy of damage or loss of spectacles, enables many men to return immediately to their fighting units. Thus, during a battle of El Alamein one Forward Ophthalmic Unit dealt with 590 eye or spectacle casualties in one week. Of these, 180 were serious injuries and were treated and evacuated to the base, while 410 were returned to their units the same day. To the early removal of intraocular foreign bodies, to prompt operation on corneal and scleral wounds or on prolapse of uveal tissue soon after the injury, is attributed a great deal of sight saving, although some credit must be given to advances in surgery.

R. Grunfeld.

Gutzeit, E. E. **Medical-social aspects in the rehabilitation of the blind.** Outlook for the Blind, 1944, v. 38, Sept., p. 196.

The number of blind persons who will benefit by the Barden-La Follette Act is not large. Only 15 to 25 percent are employable, that is from 34,000 to 56,000 persons. The remainder are disqualified by advanced age, household responsibilities, or handicaps other than blindness.

In order to guide the blind to vocational rehabilitation it is necessary to know what practical use can be made of the various degrees of vision from 0 to 20/200. For instance, what can be expected of a man whose sight has been restored by cataract surgery but who consequently has lost his accom-

modation? What work may a glaucoma patient do, or one with retinitis pigmentosa who has lost considerable peripheral field? What precautions must a diabetic patient observe in order not to lose more vision?

R. Grunfeld.

Hamilton, J. B. **The incidence of eye disease in the Australian imperial forces, Middle East.** Brit. Jour. Ophth., 1944, v. 28, Aug., pp. 383-393.

This report covers 5,650 diseased conditions seen in 3,638 patients during 1941 and 1942. The report is compared with a previous publication by the author of 14,317 diseased conditions in a survey of 6,458 private patients seen in Tasmania between 1931 and 1939. The figures and percentages of civil and war eye disease are arranged in five tables for comparative study. A general survey shows that there is less eye disease in military than in civil life. There are fewer eye injuries, and on the medical side, the percentages of iritis, keratitis, choroiditis, retinitis, and retinal detachment are also lower in the army than in civil life.

The refractive errors in the army show a percentage of 64 as compared with 95 percent in civil life. Astigmatism was the commonest refractive error, being found in about 40 percent of the army cases. Muscular anomalies were recorded in 20 percent of the army cases as compared with 24 percent of the civilian cases. Hasty recruiting is the explanation advanced for the high percentages of refractive errors and muscular anomalies. There were as many amblyopias ex anopsia in army personnel as in civil life, which also shows hasty recruiting. Iritis and iridocyclitis were very rare in the army, possibly because of the early use of sulfanilamide by mouth. Not one case of trachoma was found in the entire series. (5 tables.) Edna M. Reynolds.

Krakov, C. V. **Physiologic optics in the Soviet Union for twenty-five years.** Viestnik Oft., 1942, v. 21, pt. 6. p. 42.

While studies in physiologic optics in Russia date from the last century, it was only after the Revolution that institutions devoted exclusively to the study of physiologic optics were established. The institutions established during the last 25 years in Moscow are: the Lazarev Institute of Biophysics with an extensive division for the study of vision; the laboratory of psychophysiologic sensations at the Institute of Psychology; the laboratory of physiologic optics at the Helmholtz Institute; the laboratory of physiologic optics at the Soviet Institute of Experimental Medicine; and the laboratory of technical illumination of the Safety Institute for Workers. In Leningrad is the laboratory of physiologic optics at the National Institute of Optics. Studies in the physiology of vision are being pursued in the department of physiology at the Military Academy of Medicine, in the technical illumination division of the Leningrad Institute for the Protection of Work, in the experimental laboratory of the Leningrad Ophthalmologic Institute, and in the First Leningrad Medical Institute. The Ukraine Ophthalmologic Institute pursues similar studies. Over a thousand publications have been issued in this field, and two volumes on problems of physiologic optics. Ray K. Daily.

Lake, M. M. **Some observations on the problem of rural rehabilitation.** Outlook for the Blind, 1944, v. 38, Oct., p. 221.

Among the branches of agriculture in which the blind may become suc-

cessful are poultry raising, dairy farming, gardening, and marketing of products. But in each case the blind man needs assistance and supervision by his wife or some other member of the family. R. Grunfeld.

Livingston, P. C. **Visual problems of aerial warfare. 1. "Night": studies in the dark-adapted eye.** The Lancet, 1944, v. 247, July 8, p. 33. (See Section 10, Retina and vitreous.)

Livingston, P. C. **Visual problems of aerial warfare. 2. "Day": studies of photopic vision.** The Lancet, 1944, v. 247, July 15, p. 67. (See Section 12, Tracts and centers.)

Sanders, T. E. **A method for the projection of eye specimens.** Amer. Jour. Ophth., 1944, v. 27, Dec., pp. 1424-1425.

Sherman, A. R. **Eye injuries in industry and determination of their disability.** Jour. Med. Soc. New Jersey, 1944, v. 41, Sept., p. 332.

Eye injuries in industry differ from other injuries only in that one must keep more detailed records on which he can base necessary reports. The author discusses various types of injury, common and uncommon. He also relates how the Medical Society of New Jersey standardized methods by which the percentage loss of vision was to be determined. This method was accepted by ophthalmologists and by the compensation courts of New Jersey. Other methods are also given. A method of determining visual-field loss is added. Theodore M. Shapira.

Shortley, M. J. **Vocational rehabilitation for the visually handicapped.** Outlook for the Blind, 1944, v. 38, Sept., p. 186.

The author, as Director of the Office of Vocational Rehabilitation of the Federal Security Agency in Washington, outlines the federal and state program of vocational rehabilitation. Until 1920 only private organizations were interested in the rehabilitation of the handicapped. The first vocational rehabilitation law was enacted in 1920. In the next 20 years 210,000 handicapped were rehabilitated throughout the United States. Federal funds were limited and the state legislatures were indifferent. Under the Barden-La Follette Act, which became law in July, 1943, federal funds are now available for medical and vocational diagnoses, vocational counseling, physical restoration, and vocational training with maintenance during training. All handicapped persons are eligible irrespective of financial status. Only static conditions may be treated and the medical services must be of such nature that they may reduce or eliminate substantially the employment handicap.

There are in this country about 230,000 blind persons, to whom must be added the partially sighted. The latter may be grouped as follows: (a) 25 percent general loss of vision, (b) loss of one eye, (c) 20/60 corrected vision in the better eye, (d) better than 20/60 vision if progressive. R. Grunfeld.

Sitchevska, Olga. **Heredity and eye diseases.** Med. Women's Jour., 1944, v. 51, Oct., p. 17.

About 14 percent of blindness among children of school age and 10 percent of adult blindness are due to heredity. However, due to the complexity of hereditary mechanisms it is difficult to give definite advice to patients affected with serious eye diseases which have a hereditary tendency.

The dominant character of inheri-

tance in which half of the offspring will be diseased is manifest in congenital night blindness, blue sclerotics with bone fragility, ptosis, many types of cataract, ectopia lentis, coloboma of the iris, aniridia, familial types of corneal opacities, and certain types of myopia. In these, when two normal individuals marry, their progeny will never inherit the disease.

The recessive character is shown by retinitis pigmentosa, albinism, anophthalmos, buphthalmos, hydrophthalmos, and infantile glaucoma. Consanguinity is considered an important factor in the production of retinitis pigmentosa and albinism.

The most common type of transmission of the sex-linked character is that in which the descent is through the X chromosome, therefore dominant in the male and recessive in the female. This type of transmission is present in Leber's optic atrophy, congenital color blindness, congenital nystagmus, and hemophilia. Sons of affected fathers are normal and do not transmit the disease, while the daughters appearing normal but possessing the recessive tendency transmit the condition to the males.

Microphthalmos may be either a recessive or a dominant characteristic in a hereditary strain. Some feel that microphthalmics should not reproduce and that no more children should be allowed parents of a microphthalmic child.

Keratoconus likewise may show definite hereditary tendencies, as may Groenouw's nodular keratitis.

Owen C. Dickson.

NEWS ITEMS

Edited by Dr. Donald J. Lyle
904 Carew Tower, Cincinnati 2

News items should reach the editor by the twelfth of the month

Deaths

Dr. Scott C. Applewhite, San Antonio, Texas. died November 17, 1944, aged 68 years.

Dr. Aaron Brav, Philadelphia, Pennsylvania, died December 2, 1944, aged 69 years.

Dr. Joseph H. Crampton, Seattle, Washington, died November 9, 1944, aged 60 years.

Dr. John S. Gordon, Milwaukee, Wisconsin, died December 6, 1944, aged 56 years.

Dr. John E. Hiess, Perry, Oklahoma, died December 14, 1944, aged 60 years.

Dr. Jacob O. Hoffman, Harrisonburg, Virginia, died September 4, 1944, aged 84 years.

Dr. Frederick P. Parker, Saint Louis, Missouri, died November 18, 1944, aged 75 years.

Miscellaneous

The complete program for the Ophthalmological Seminar which will be held April 19, 20, 21, 1945, in Atlanta, in honor of the memory of Dr. Abner Wellborn Calhoun, is as follows:

Thursday, April 19, 1945

4:00 p.m.—Emory University Hospital Auditorium. Dr. W. I. Lillie, Philadelphia, "Clinical significance of diplopia."

5:00 p.m.—Reception—A. W. Calhoun Medical Library.

7:00 p.m.—Academy of Medicine. Buffet supper—Guest of Women's Auxiliary.

8:00 p.m.—Academy of Medicine. Dr. Frank B. Walsh, Baltimore, "Clinical diagnostic features of migraine."

9:00 p.m.—Dr. Walter I. Lillie, "Neuro-ophthalmology with special reference to retrobulbar neuritis."

Friday, April 20, 1945

10:00 a.m.—Grady Hospital Senior Lecture Room. Dr. Frank B. Walsh, "The ocular signs of subdural hematoma in infants and adults."

11:00 a.m.—Dr. William Benedict, Rochester, Minnesota, "Exopthalmos."

1:00 p.m.—Luncheon—Guest of Grady Hospital.

3:00 p.m.—Academy of Medicine. Dr. Parker Heath, Detroit, "Random notes on ocular surgery."

4:30 p.m.—Dr. William Benedict, "Discussion of superficial keratitides."

6:30 p.m.—Biltmore Hotel. Dinner—Guest of Emory University.

8:00 p.m.—Academy of Medicine. Dr. Parker Heath, "Some recent advances in ocular therapeutics."

9:00 p.m.—Dr. John Dunnington, New York City, "Surgical treatment of vertical deviations."

Saturday, April 21, 1945

10:00 a.m.—Academy of Medicine. Dr. Harry Gradle, Chicago, "Observations on the surgery of retinal detachments."

11:00 a.m.—Dr. John Dunnington, "Plastic surgery of the lids."

1:00 p.m.—Biltmore Hotel. Luncheon—Guest of Eye Department.

2:30 p.m.—Academy of Medicine. Col. Derrick Vail, Cincinnati, "Ophthalmology in war."

3:30 p.m.—Dr. Harry Gradle, "Ocular complications of polyarthritis."

4:30 p.m.—Dr. John Dunnington, "Use of penicillin in ophthalmology."

6:30 p.m.—Biltmore Hotel. Dinner—Guest of Emory University.

8:00 p.m.—Academy of Medicine. Dr. Harry Gradle, "Surgical treatment of glaucoma."

9:00 p.m.—Col. Derrick Vail, "Ophthalmology in war."

The Saint Louis Ophthalmic Society and the Department of Ophthalmology of Washington University offers an eight-months' course for orthoptic technicians. The theoretical instruction will be given at the Oscar Johnson Institute and the practical work at the Saint Louis Ophthalmic Laboratory. The course is limited to three students; tuition $300. For information write to the Saint Louis Ophthalmic Laboratory, Missouri Theatre Building, 634 North Grand Boulevard, Saint Louis 3, or to Dr. Lawrence T. Post, 640 South Kingshighway, Saint Louis 10.

The eleventh annual postgraduate course of the Virginia Society of Ophthalmology and Otolaryngology was held at the University of Virginia Department of Medicine, Charlottesville, December 5th to 8th. Participating in the program were: Drs. Paul H. Holinger, Russell L. Cecil, Frederick M. Law, John R. Page, Joseph D. Kelly, McLemore Birdsong, Marion Lawrence White, Jr., James W. White, Wendell L. Hughes, William E. Fry, and Paul A. Chandler.

According to a recent announcement the University of Illinois College of Medicine received an anonymous gift of $20,000 for visual aid studies.

A course in slitlamp microscopy of the living eye combined with a course in glaucoma surgery was given by the Committee on Graduate Education of the Allegheny County Medical Society on February 12th to 14th. The course was conducted by the department of ophthalmology of Montefiore Hospital under the direction of Dr. Harvey E. Thorpe and his associates.

Societies

The Brooklyn Ophthalmological Society held its regular meeting on February 15th at the Towers Hotel, Brooklyn. A paper on "Wernicke's disease—encephalitis hemorrhagica superior" was presented by Dr. Daniel Kravitz and a discussion by Dr. Robert H. Stockfisch followed. The scientific program was concluded with a lecture by Dr. Raymond L. Pfeiffer on "Exophthalmos."

The Kansas City Society of Ophthalmology and Oto-Laryngology will present an oil painting of Dr. Hal L. Foster to the American Academy of Ophthalmology and Otolaryngology at the fiftieth anniversary of the Academy, provided the 1945 session is held. Dr. Foster founded the national organization at a meeting in Kansas City in April, 1896.

At the January dinner meeting of the Cleveland Ophthalmological Club, Dr. Harold Francis Falls of the Department of Ophthalmology, University of Michigan, spoke on "Ophthalmic syndromes." The lecture was illustrated with lantern slides showing unusual cases which the speaker had observed.

The following officers have been elected by the Sociedad de Estudios Clínicos de la Habana for the biennium 1945-46: president, Dr. Julio F. Schulte Viciedo; vice-president, Dr. José Lastra Camps; secretary, Dr. Frank Canosa Lorenzo; vice-secretary, Dr. Luis Rodríguez Baz; treasurer, Dr. Luis Ortega Verdes; vice-treasurer, Dr. Alvaro Silva López del Rincón.

Personals

Dr. Harry S. Gradle, President of the Pan-American Congress of Ophthalmology, who is now in South America on a speaking tour, has found all of the leading ophthalmologists in Latin America enthusiastic about the next meeting of the Congress, which is scheduled for November 25-30, 1945, in Montevideo, Uruguay. He has met with many of the South American ophthalmologists of the Congress and with the arrangements committee in Montevideo, and reports that the program is set up and all preliminary arrangements are completed.

Dr. Earling W. Hansen, Professor of Ophthalmology at the University of Minnesota School of Medicine, gave an instructive talk on "The mechanism of uveitis" at the November dinner meeting of the Cleveland Ophthalmological Club.

JUST BEFORE GOING TO PRESS WORD WAS RECEIVED THAT COL. DERRICK VAIL HAD BEEN APPOINTED CHIEF CONSULTANT IN OPHTHALMOLOGY, SURGERY DIVISION, IN THE SURGEON GENERAL'S OFFICE. THIS APPOINTMENT WILL PERMIT COLONEL VAIL TO RESUME A PART OF HIS EDITORIAL DUTIES ON THIS JOURNAL. THE STAFF WELCOMES HIM MOST HEARTILY AND CONGRATULATES HIM ON HIS NEW APPOINTMENT AND ON WORK WELL DONE OVERSEAS FOR THE LAST TWO AND A HALF YEARS. HIS ADDRESS IS COL. DERRICK VAIL (MC) 0491780, OFFICE OF THE SURGEON GENERAL, 1818 N STREET N.W., WASHINGTON, D.C.